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NASA Technical Paper 1071

Development of a Procedure to Model High-Resolution Wind Profiles From Smoothed or Low-Frequency Data

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Development of a Procedure to Model High-Resolution Wind Profiles From Smoothed or Low-Frequency Data

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NASA
National Aeronautics
and Space Administration

Scientific and Technical
Information Office

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NOMENCLATURE

$\bar{u}$	Mean zonal wind speed component (m/sec)
$\bar{v}$	Mean meridional wind speed component (m/sec)
W	Scalar wind speed from rawinsonde data (m/sec)
θ	Wind direction (direction wind is from) measured from the north in a clockwise direction (deg)
M	Some integer
X	A variable
k	Integer (1, 2, ..., M + 280)
N(k)	The k^{th} value from a set of random numbers
i	Subscript 1 or 2 depending on which set of random numbers is used
I	A computed number
u'	Zonal wind gust speed (m/sec)
v'	Meridional wind gust speed (m/sec)
σ_{X_1}	Standard deviation of random number set used in zonal wind component computation (assigned units of m/sec)
σ_{X_2}	Standard deviation of random number set used in meridional wind component computation (assigned units of m/sec)
$\sigma(Z_n)$	Standard deviation (computed from curve fit) of Kennedy Space Center, Florida, Jimsphere data (m/sec)
Z	Altitude above sea level (km)
u	Total zonal wind component ($\bar{u}$ + u') (m/sec)
v	Total meridional wind component ($\bar{v}$ + v') (m/sec)
WS	Computed simulated Jimsphere scalar wind speed (m/sec)
Q	Quadrant correction angle (deg)
j	A summation index

CHAPTER I

INTRODUCTION

In the fall of 1974, it was determined that neither the necessary number of high resolution Jimsphere wind profiles existed for Vandenberg Air Force Base, California, nor was time available to collect the required number of profiles for use in the creation of design verification data tapes for use in the Space Shuttle Program. The requirement of using the high resolution Jimsphere wind profiles for design verification studies resulted because these data are the most accurate and detailed wind measurements available. There are many articles on the Jimsphere system and its accuracy; see, for example, Scoggins (1),[1] Susko and Vaughan (2), Fichtl, Camp, and Vaughan (3), Camp (4), and Camp and Vaughan (5). Simulated high-resolution Jimsphere wind profiles were modeled from existing serially complete rawinsonde data (6) from Vandenberg Air Force Base and from use of generated white noise data. The serially complete rawinsonde data set used consisted of eight years of twice daily rawinsonde flights with no missing tests or data points within any test. These rawinsonde data have a wind speed and direction value for each kilometer from the Earth's surface to 27 kilometers. In compiling the serially complete data if a data point had been missing in the original raw data, a value was determined and inserted by a consideration of nearby

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[1]Numbers in parentheses refer to similarly numbered references in the Bibliography.

rawinsonde flights, previous, and following rawinsonde flights for the Vandenberg Air Force Base area. The determination of the value to be inserted was accomplished by a competent meteorologist. This study presents a discussion on how these serially complete rawinsonde data were used along with the generated white noise data to derive simulated Jimsphere wind profiles.

The sample size for the Vandenberg Air Force Base simulated Jimsphere wind profile verification information set is the same as the data set for the Kennedy Space Center, Florida, verification data, i.e., 150 profiles per month (7). The tape format used in storing the data Vandenberg Air Force Base information on magnetic tape is also the same as that used for the Kennedy Space Center data set.

CHAPTER II

COMPUTATION OF SIMULATED JIMSPHERE PROFILES

The Vandenberg Air Force Base rawinsonde wind data for the period January 1965 through December 1972 were used to construct the simulated Jimsphere wind profile verification data. These rawinsonde data are tabulated and stored on magnetic tape as scalar wind speed and direction having a data increment of 1.0 kilometer. From these data the zonal (u) and meridional (v) wind components were determined by

$$\bar{u} = -W \sin \theta \tag{2.1}$$

and

$$\bar{v} = -W \cos \theta \tag{2.2}$$

where θ is wind direction measured from the north in a clockwise direction. The rawinsonde scalar wind speed and direction data are considered to be mean values. Care must be exercised to be sure these components have the correct meteorological sign notation. Wind components from the north and east are negative and those from the south and west are positive (see Equation 2.18).

The meridional and zonal wind components were curve fitted using a cubic spline routine. These curve-fit data were tabulated and stored. The altitude increment used in the data storage was 25 meters.

The next step consists of the generation and storage of two sets of random numbers using any readily available computer program. Both sets of random numbers have a Gaussian distribution with standard deviation and mean value of 1 and 0, respectively (7). The method used to generate these sets of numbers and their ordering has been discussed by Perlmutter (8). However, it is expedient to briefly discuss the procedure in order to maintain continuity. Each set of random numbers contains M + 280 values, where M is some predetermined integer. The number 280 comes from the fact that the use of 28 values of the sets will yield stationarity. However, by using 10 times this number we are assured that the stationarity condition cannot be violated. Next compute two sets of M + 280 successive values of X using the following recursion equations.

$$X_i(k + 1) = 0.865\ X(k) - 0.286\ I(k) + 0.184\ N(k) - \bar{X}_i \qquad (2.3)$$

and

$$I(k + 1) = I(k) + 0.111\ X(k) \qquad (2.4)$$

where

$$I(1) = X(1) = 0 \qquad (2.5)$$

The X_1 and X_2 sets of numbers are used in computing the meridional and zonal wind components, respectively. Proceeding, the first (M + 1) values of X_i are discarded to eliminate nonstationary effects due to the initialization

process. The remaining values of X_i are used to compute wind gust profiles as follows:

$$u'_n = \left(\frac{X_1(n) - \bar{X}_1}{\sigma_{X_1}}\right)\sigma(Z_n) \qquad (2.6)$$

and

$$v'_n = \left(\frac{X_2(n) - \bar{X}_2}{\sigma_{X_2}}\right)\sigma(Z_n) \qquad (2.7)$$

where

$$\bar{X}_i = \frac{1}{280}\sum_{k=1}^{280} X_i(k) \qquad (2.8)$$

and

$$\sigma^2_{X_i} = \frac{1}{280}\sum_{k=1}^{280} [X_i(k) - \bar{X}_i]^2 \qquad (2.9)$$

The values of u'_n and v'_n are assigned an altitude according to

$$Z_n = \frac{38.75\ n}{1 - 0.002\ n} \qquad (2.10)$$

for

$n = 1, 2, \ldots, 170$

and

$$Z_n = 9{,}100 + 53.5(n - 170) \qquad (2.11)$$

for

$n = 171, 172, \ldots, 375$

To compute $\sigma(Z_n)$ in Equations 2.6 and 2.7 the following formulae (9) were used:

$$\sigma^2(Z_n) = 1.71 \tag{2.12}$$

for $Z_n \leq 9.16$ kilometers and

$$\sigma^2(Z_n) = 0.12\ e^{0.29\ Z_n} \tag{2.13}$$

for $Z_n > 9.16$ kilometers. A plot of Equations 2.12 and 2.13 is shown in Figure 1. In this figure the plotted points (0--zonal and □--meridional) are from Jimsphere data for the Kennedy Space Center. The procedure used to process the Jimsphere data from the Kennedy Space Center is discussed in a report by DeMandel and Krivo (10). The Kennedy Space Center Jimsphere data was used to determine the standard deviation to be used in the computation of these simulated Jimsphere data because only for the Kennedy Space Center was a sufficient quantity of data available to carry out this computation. It should be noted, however, that it is believed the turbulent contribution to the total wind is not significantly different between the Kennedy Space Center and the Vandenberg Air Force Base. This belief resulted from careful examinations of the small quantity of data available from the Vandenberg Air Force Base, and from lengthy

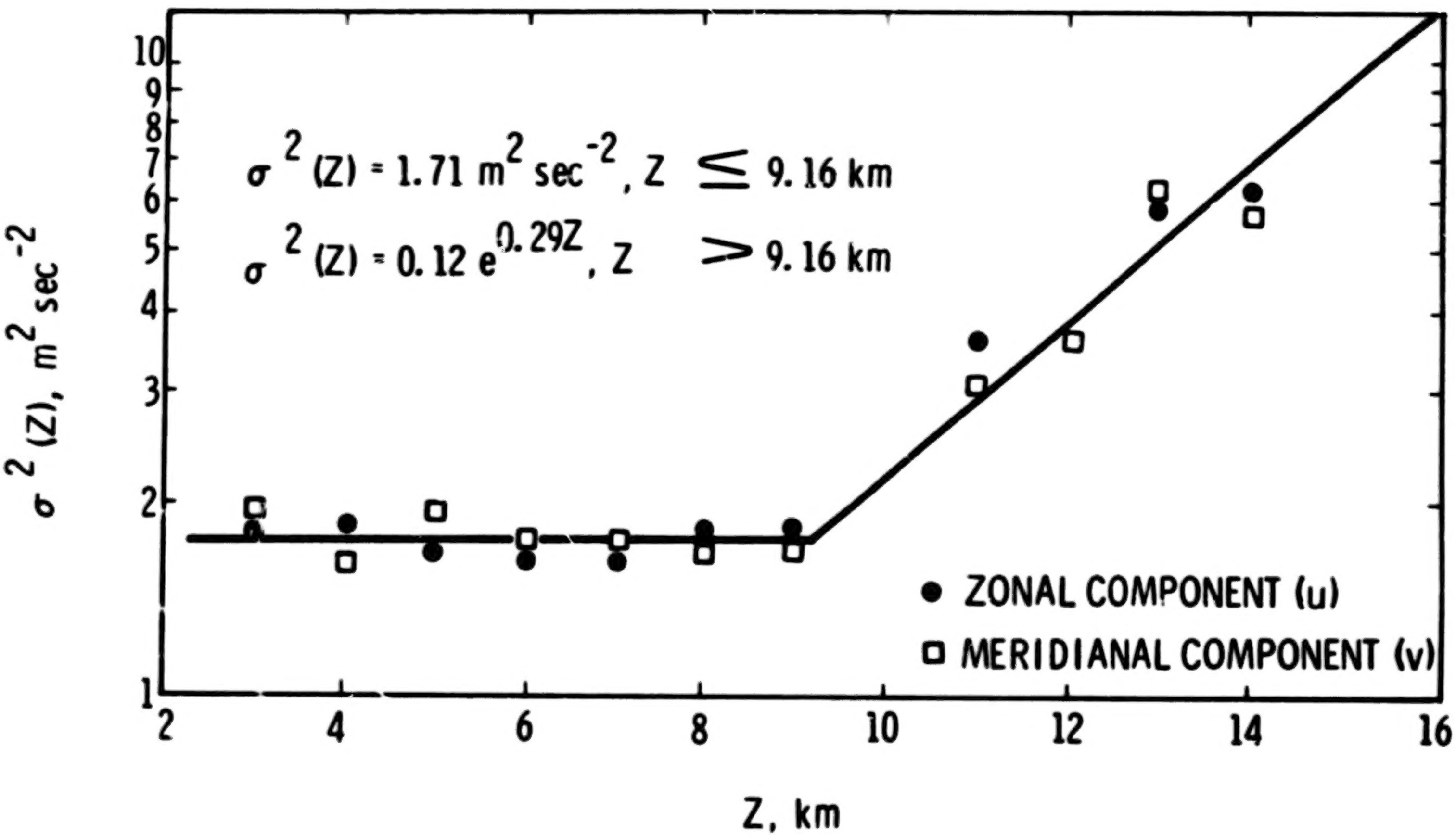

Figure 1. Zonal and meridional gust variances as a function of altitude.

discussions on comparisons of these data to the Kennedy Space Center data.

The total wind component is given by an addition of Equations 2.1 and 2.6 for the zonal wind

$$u = \bar{u} + u'_n \tag{2.14}$$

and Equations 2.2 and 2.7 for the meridional wind

$$v = \bar{v} + v'_n \tag{2.15}$$

The values for u and v are computed for each 25-meter increment of altitude. Equations 2.14 and 2.15 are used to compute the detailed simulated Jimsphere scalar wind speed profile using

$$WS = (u^2 + v^2)^{1/2} \tag{2.16}$$

and the wind direction for this scalar speed is found by use of

$$Q = \tan^{-1}\left(\left|\frac{v}{u}\right|\right) \tag{2.17}$$

Specifically, wind direction is given by

$WD = Q$	$u < 0$	and $v < 0$
$WD = Q + 180$	$u > 0$	and $v > 0$
$WD = 180 - Q$	$u > 0$	and $v < 0$
$WD = 360 - Q$	$u < 0$	and $v > 0$
$WD = 0$	$u < 0$	and $v = 0$
$WD = 90$	$u = 0$	and $v < 0$

$WD = 180 \qquad u > 0 \quad \text{and } v = 0$

$$WD = 270 \qquad u = 0 \quad \text{and } v > 0 \tag{2.18}$$

The values of wind speed and direction as computed by use of Equations 2.16 and 2.18 were recorded on magnetic tape in the Jimsphere wind profile verification tape format. This format is discussed in Chapter IV. There are 150 simulated Jimsphere wind profiles per month, for a total of 1800 profiles for Vandenberg Air Force Base, California. The reason for using 150 profiles per month resulted from a study made to determine the least number of profiles which could be used and still have statistics in agreement with the population. This study was made for the Kennedy Space Center data; however, it was desired to have the same number of profiles for both sites. A month of data is put on one magnetic tape; thus, there are 12 magnetic tapes. The data are placed on the tapes for 25-meter increments from the surface to 20 kilometers altitude. Wind speed data are given to the nearest tenth of a meter per second for each altitude increment. Wind direction is given to the nearest tenth of a degree in the meteorological manner for each altitude increment. That is, direction is measured in degrees clockwise from true north and represents the direction from which the wind is coming.

CHAPTER III

QUALITY OF SIMULATED JIMSPHERE PROFILES

When one considers how to present a discussion of data quality, it appears, at first, to be a simple task; namely, to compare the simulated set of data to a set of accurate high-resolution data and to perform a statistical analysis of the comparison. However, there exists no accurate high-resolution data set for Vandenberg Air Force Base which can be used to compare with the simulated Jimsphere wind profile data. The procedure used to check the simulated Jimsphere wind profile data might best be described as a qualitative, pseudo-quantitative method.

The mean wind components (u and v) as computed by Equations 2.1 and 2.2 were averaged for each month using an arithmetic mean,

$$\overline{X} = \frac{1}{N} \sum_{j=1}^{N} X_j \tag{3.1}$$

where N is 150 for each month of simulated Jimsphere data and is 495 for January, 453 for February, 496 for March, May, July, August, October, and December, and 480 for April, June, September, and November for the rawinsonde data. The monthly mean for the zonal and meridional simulated Jimsphere data is illustrated in Figures 2 through 13 and 14 through 25, respectively. It is to be noted that the 150 monthly

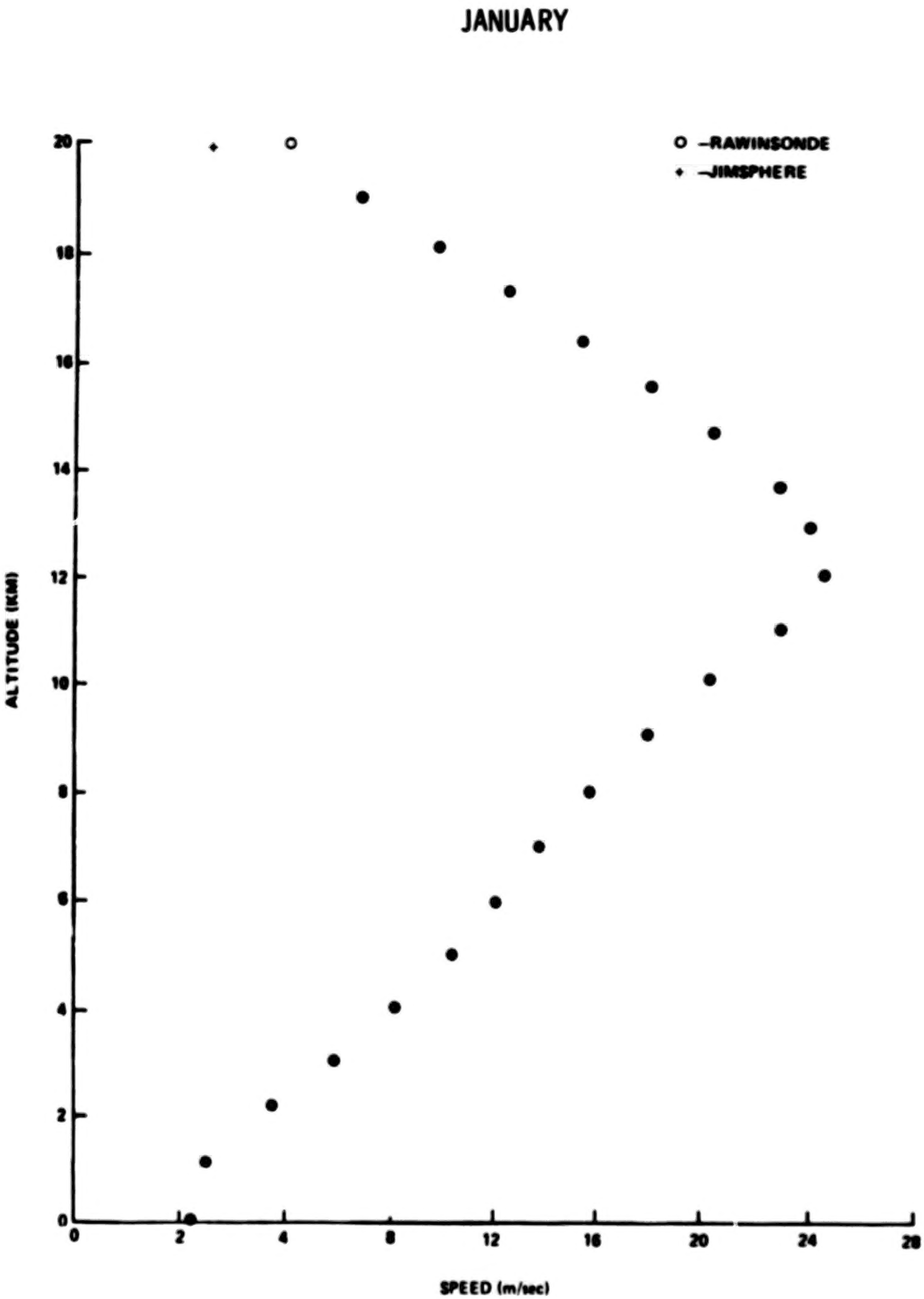

Figure 2. Comparison of the January mean zonal wind component profiles for the simulated Jimsphere and rawinsonde data.

FEBRUARY

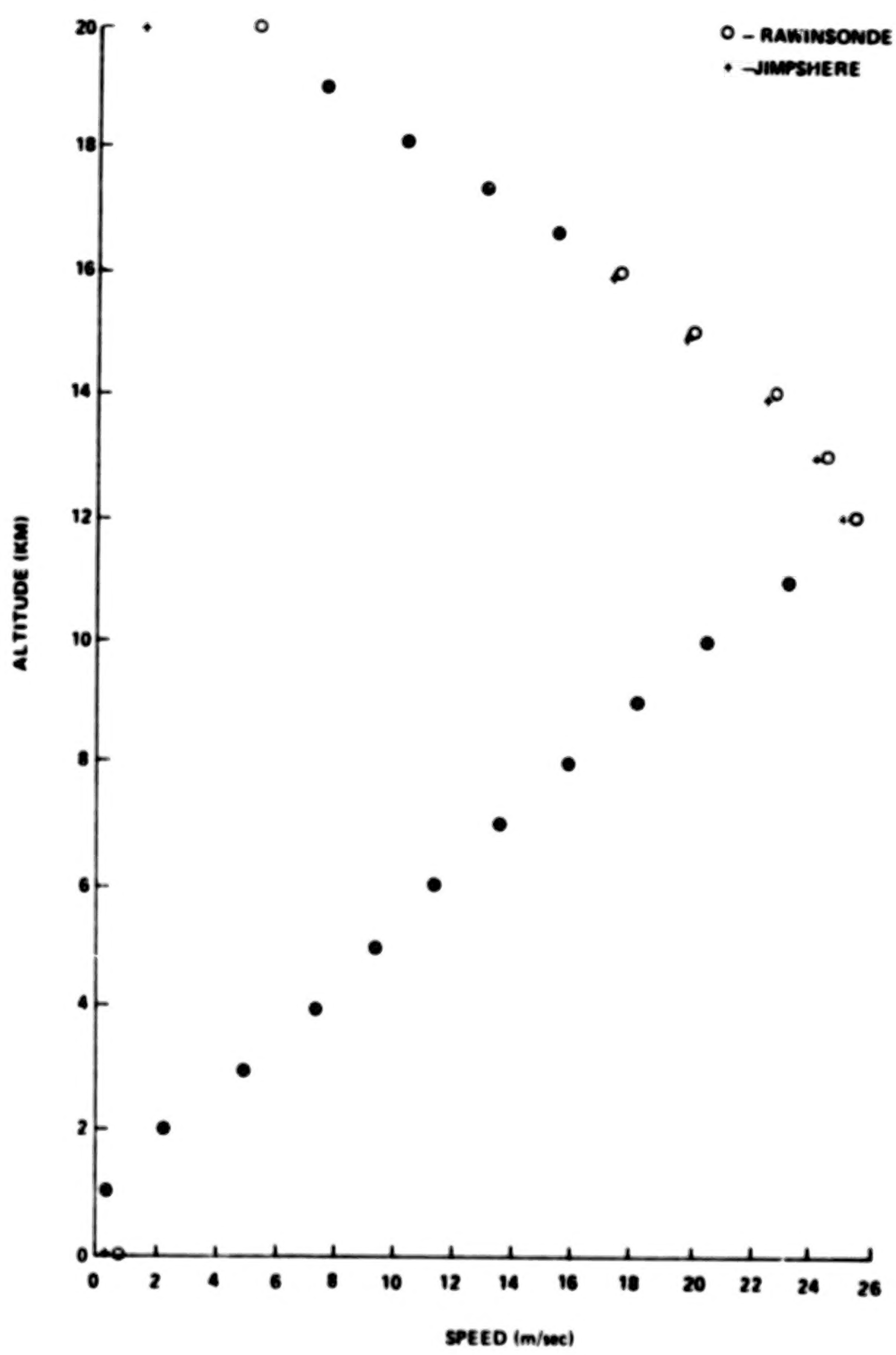

Figure 3. Comparison of the February mean zonal wind component profiles for the simulated Jimsphere and rawinsonde data.

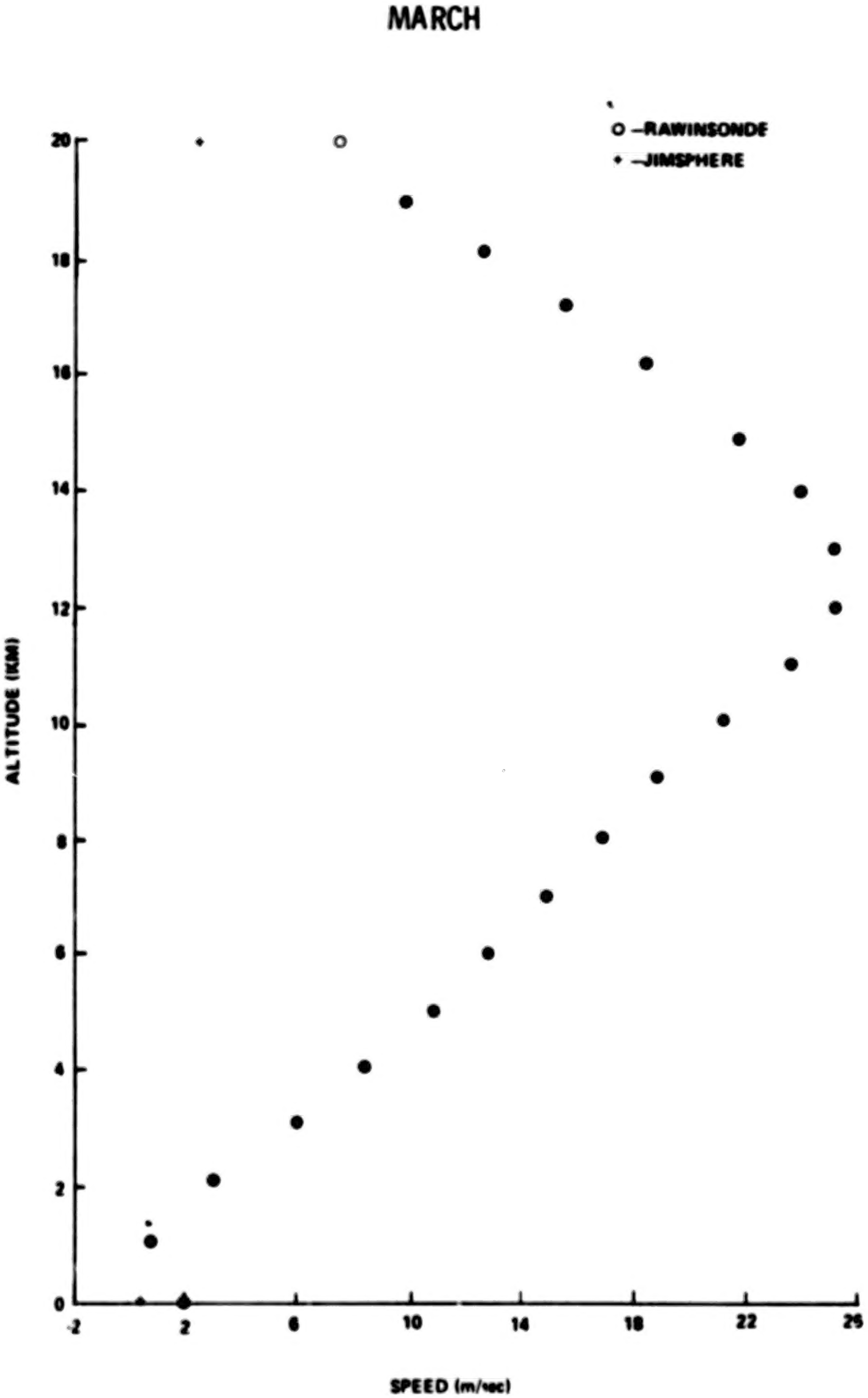

Figure 4. Comparison of the March mean zonal wind component profiles for the simulated Jimsphere and rawinsonde data.

APRIL

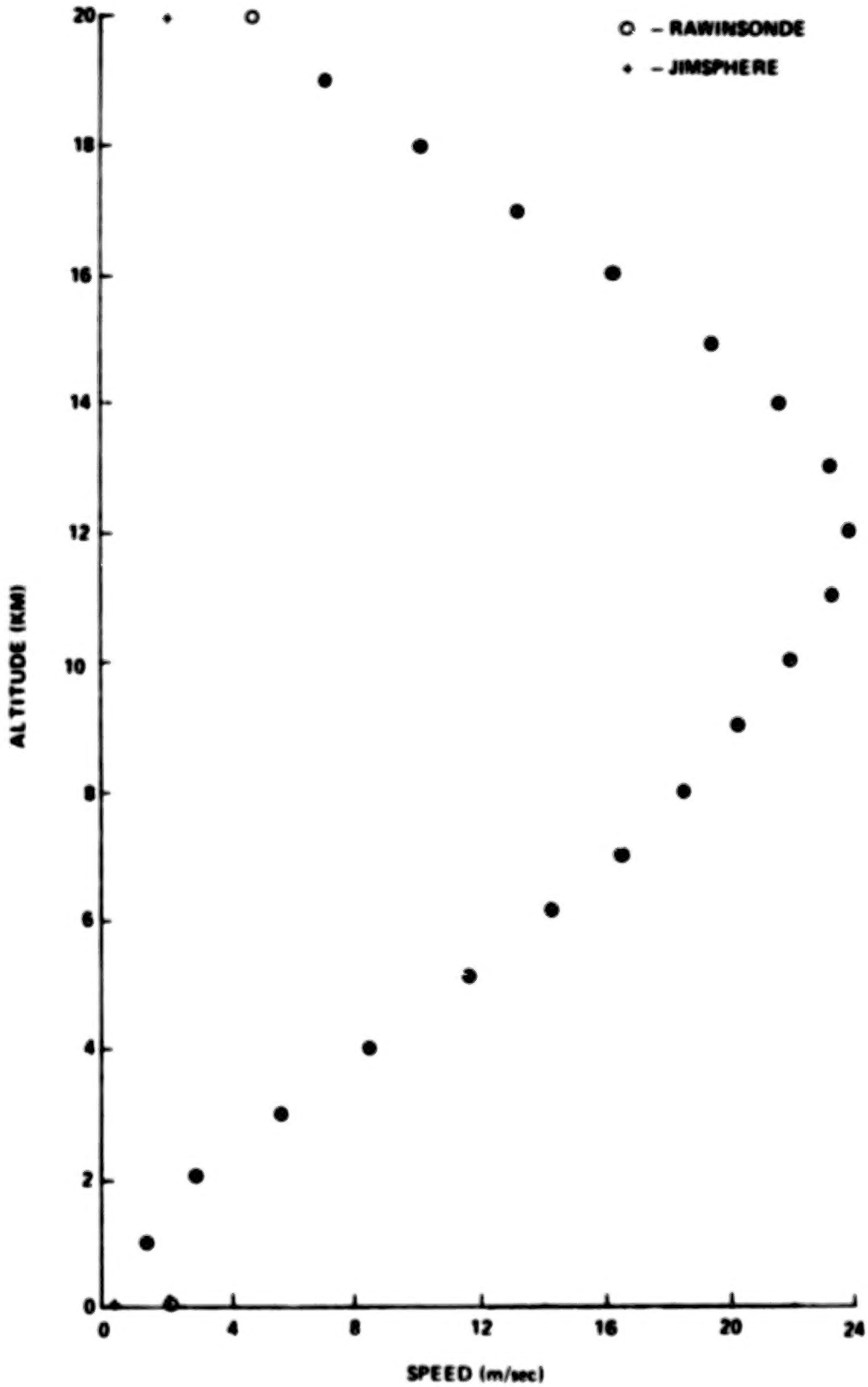

Figure 5. Comparison of the April mean zonal wind component profiles for the simulated Jimsphere and rawinsonde data.

MAY

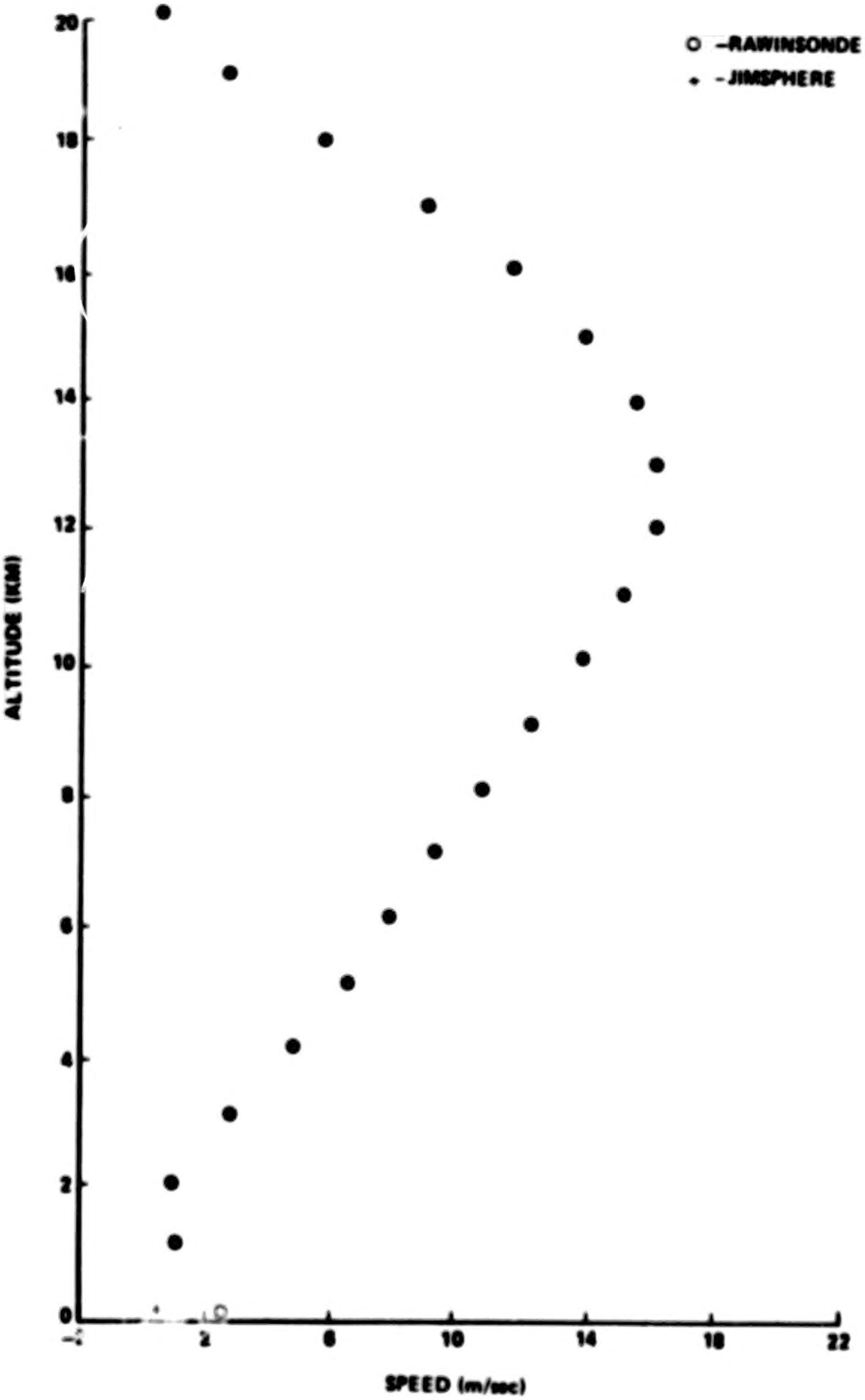

Figure 6. Comparison of the May mean zonal wind component profiles for the simulated Jimsphere and rawinsonde data.

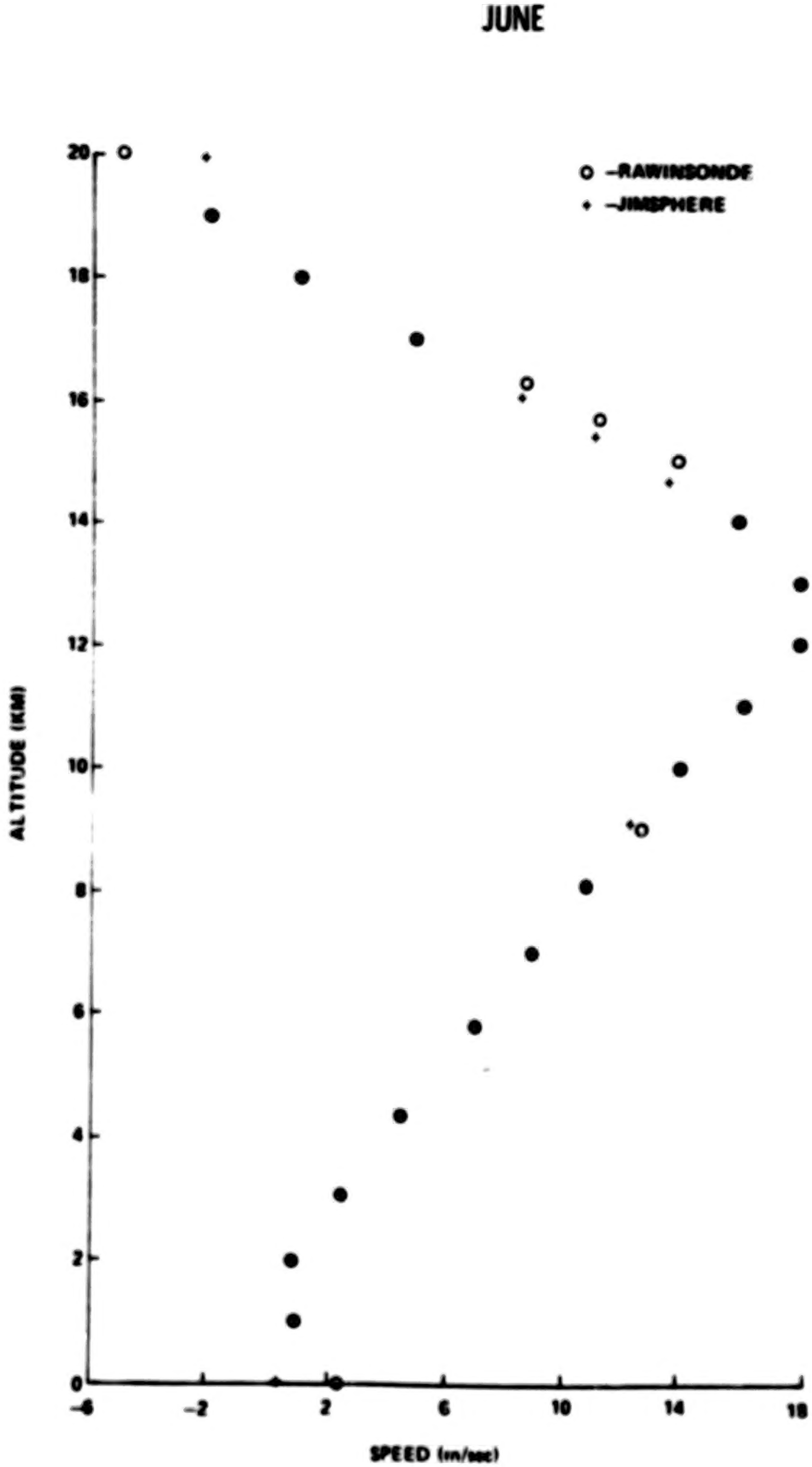

Figure 7. Comparison of the June mean zonal wind component profiles for the simulated Jimsphere and rawinsonde data.

JULY

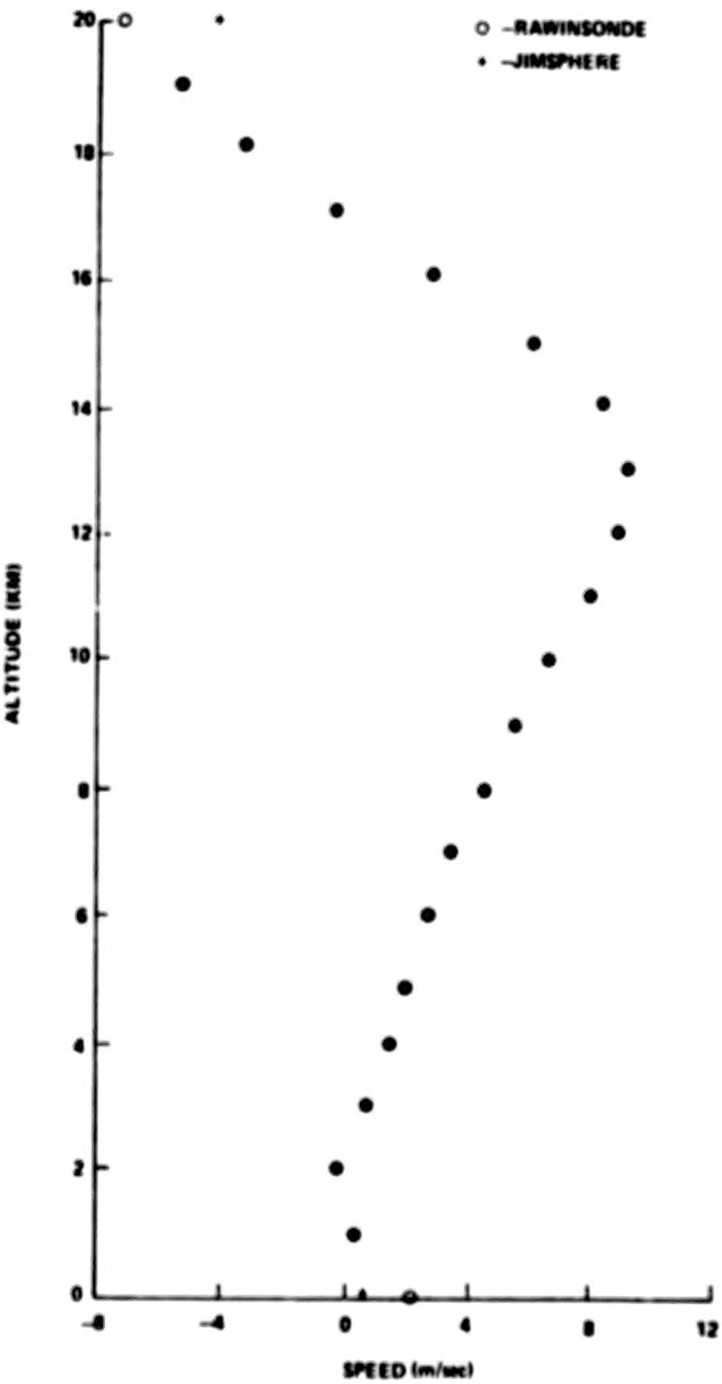

Figure 8. Comparison of the July mean zonal wind component profiles for the simulated Jimsphere and rawinsonde data.

AUGUST

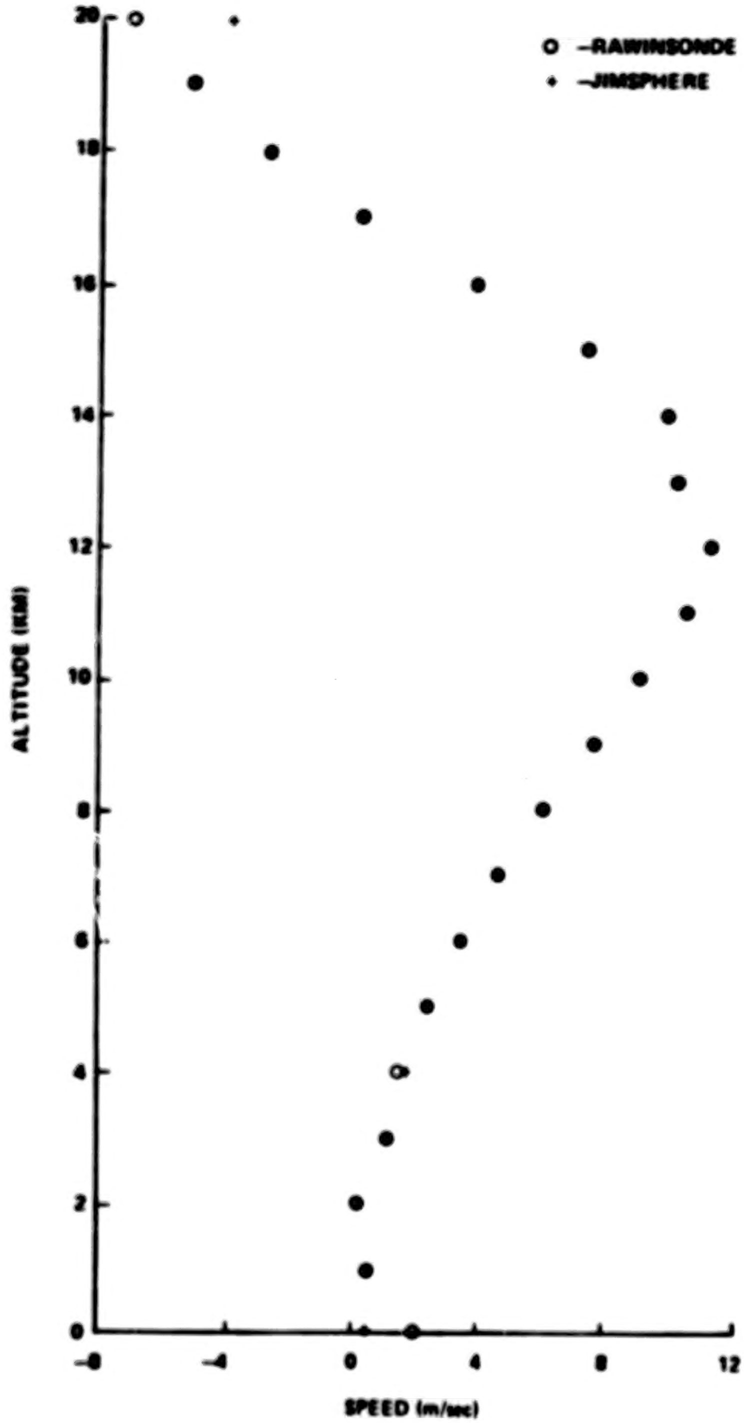

Figure 9. Comparison of the August mean zonal wind component profiles for the simulated Jimsphere and rawinsonde data.

SEPTEMBER

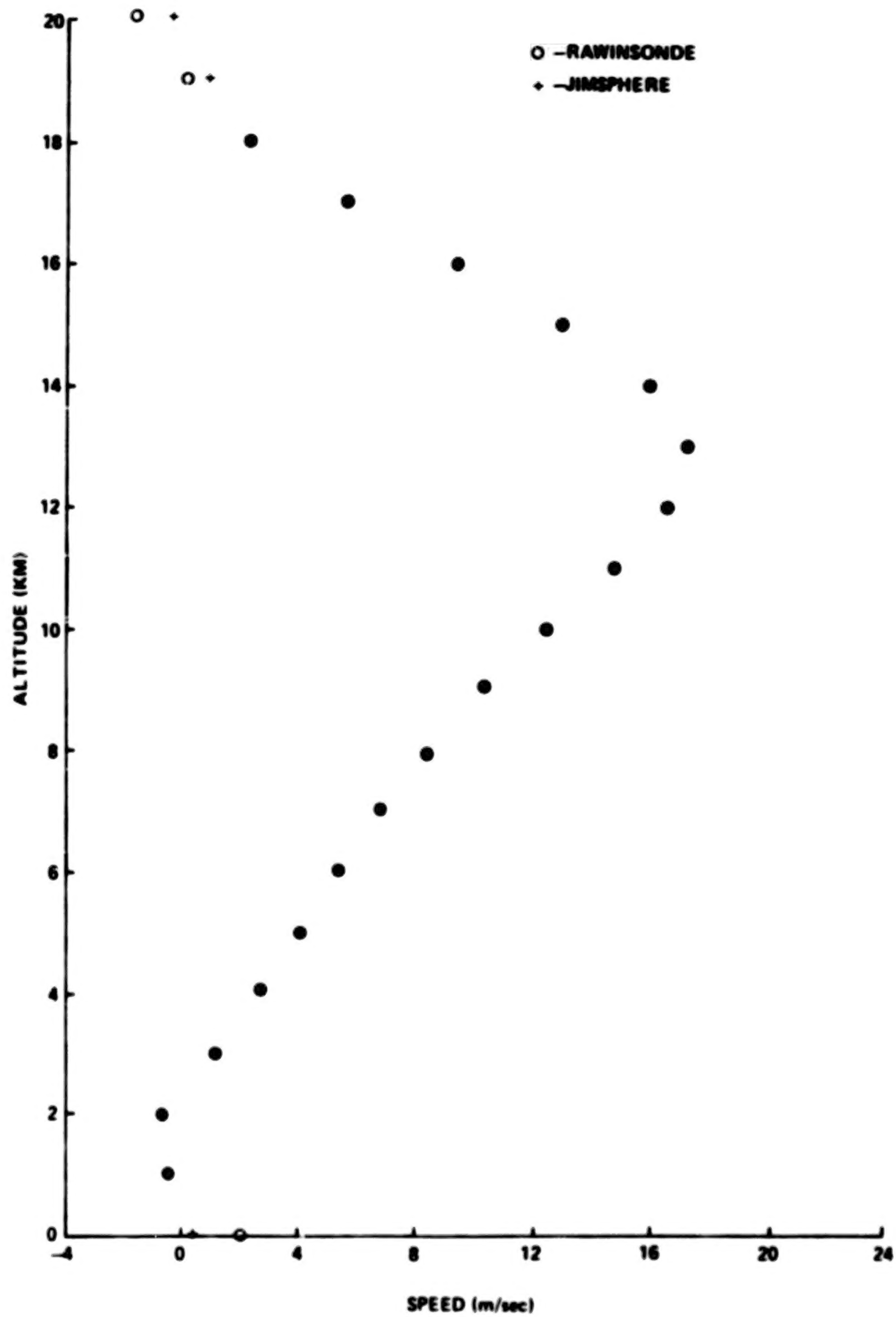

Figure 10. Comparison of the September mean zonal wind component profiles for the simulated Jimsphere and rawinsonde data.

OCTOBER

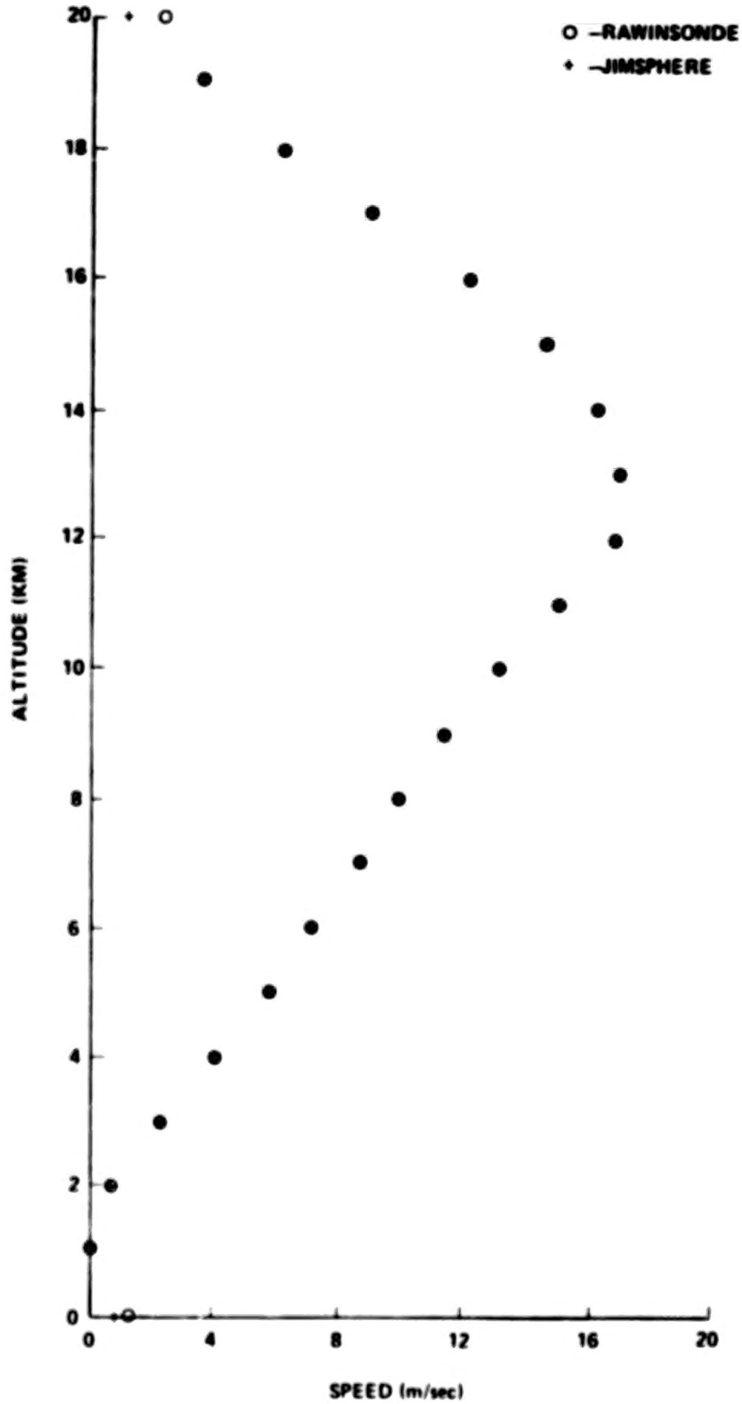

Figure 11. Comparison of the October mean zonal wind component profiles for the simulated Jimsphere and rawinsonde data.

NOVEMBER

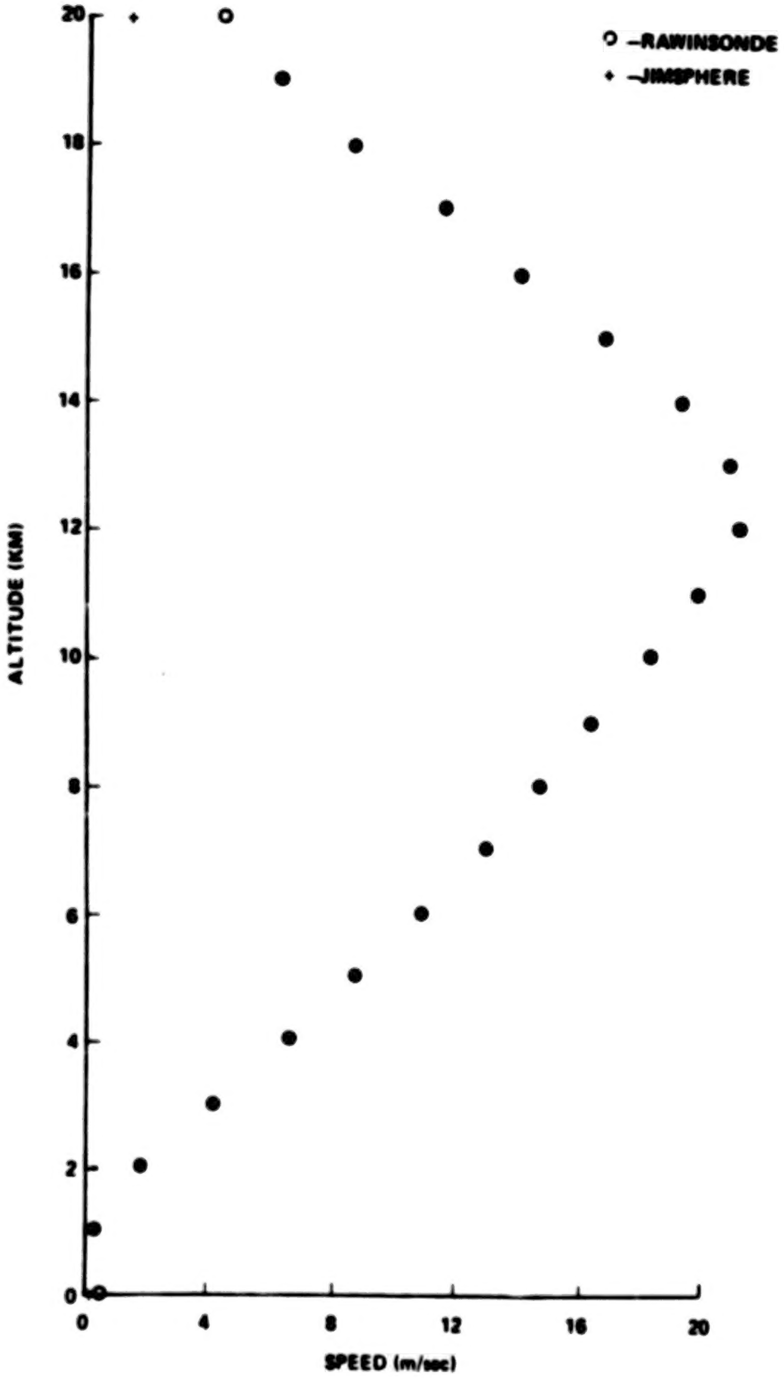

Figure 12. Comparison of the November mean zonal wind component profiles for the simulated Jimsphere and rawinsonde data.

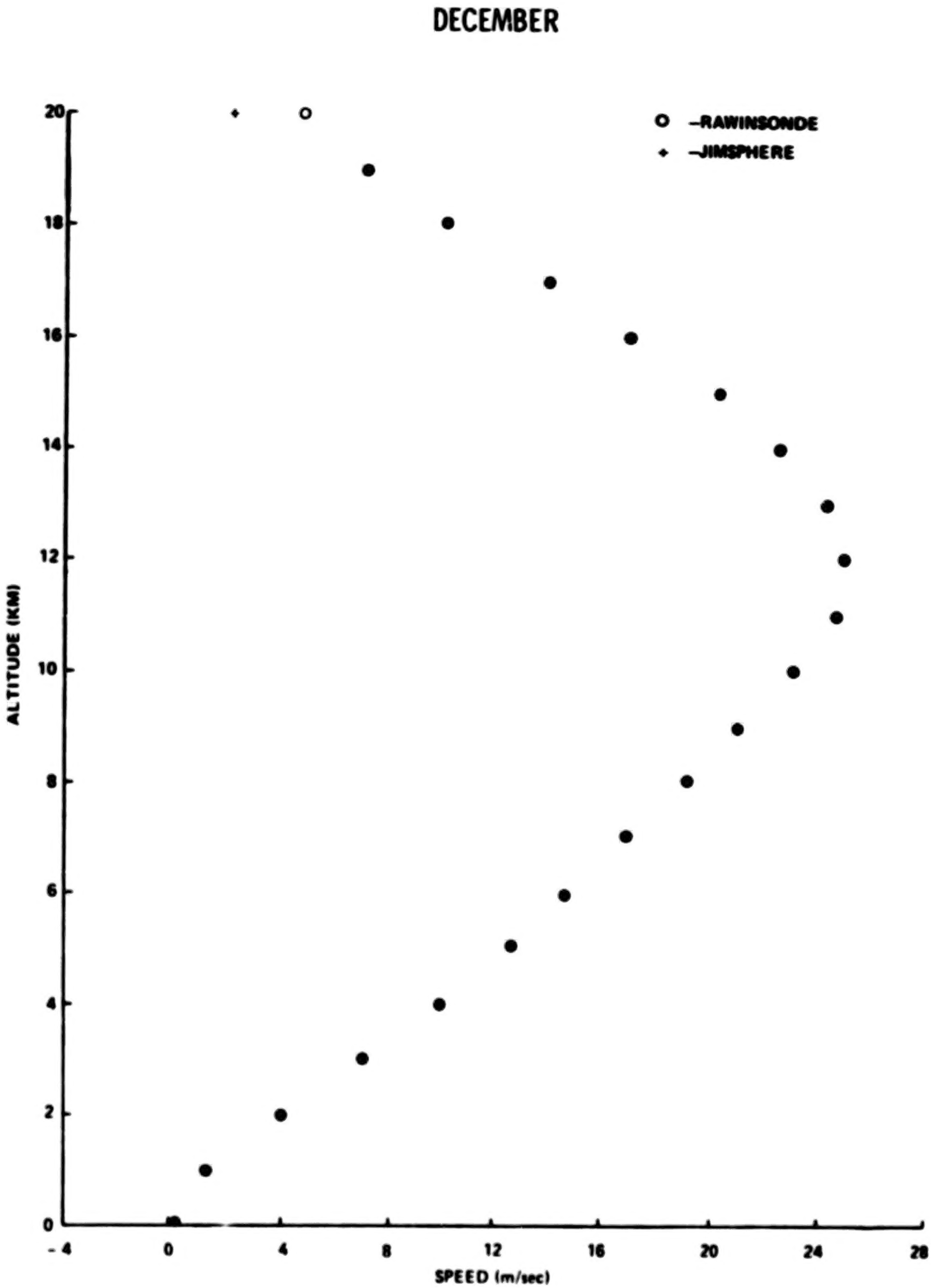

Figure 13. Comparison of the December mean zonal wind component profiles for the simulated Jimsphere and rawinsonde data.

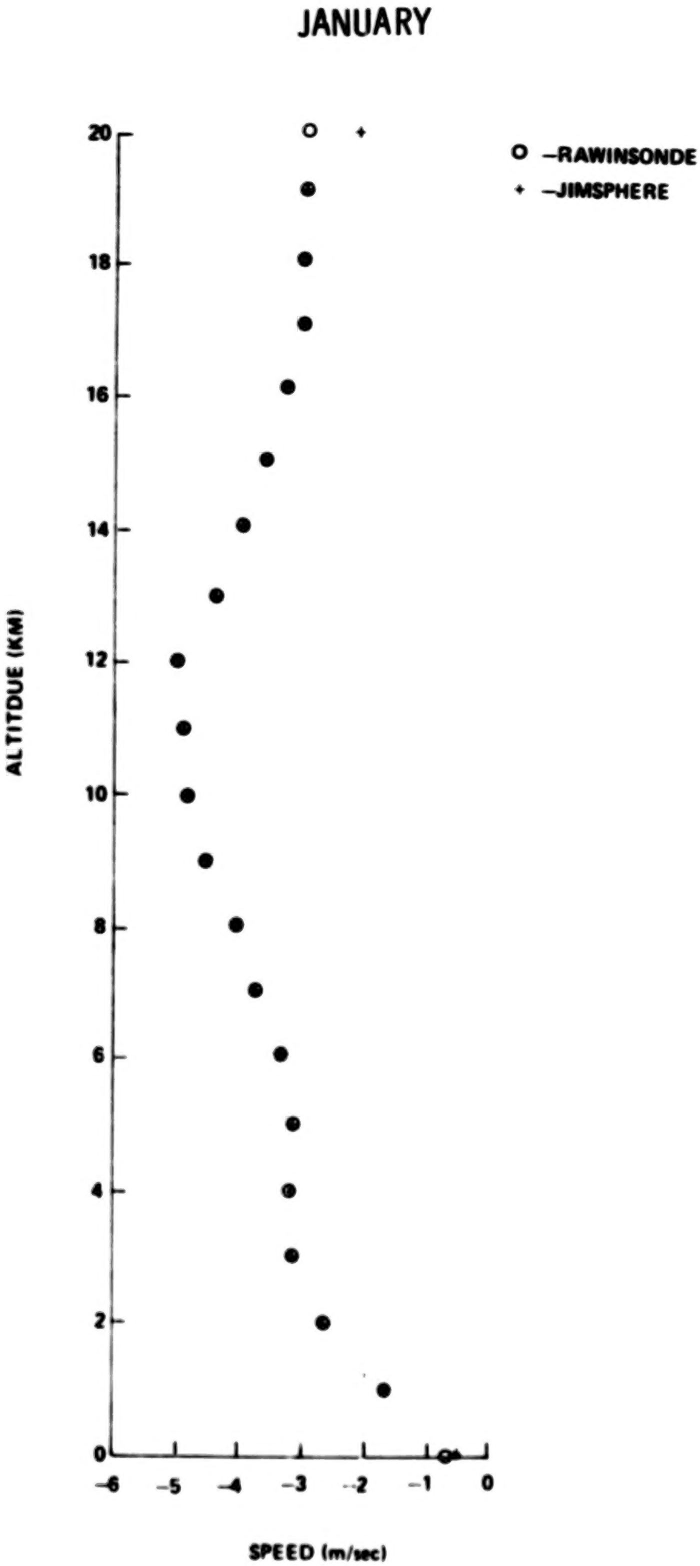

Figure 14. Comparison of the January mean meridional wind component profiles for the simulated Jimsphere and rawinsonde data.

FEBRUARY

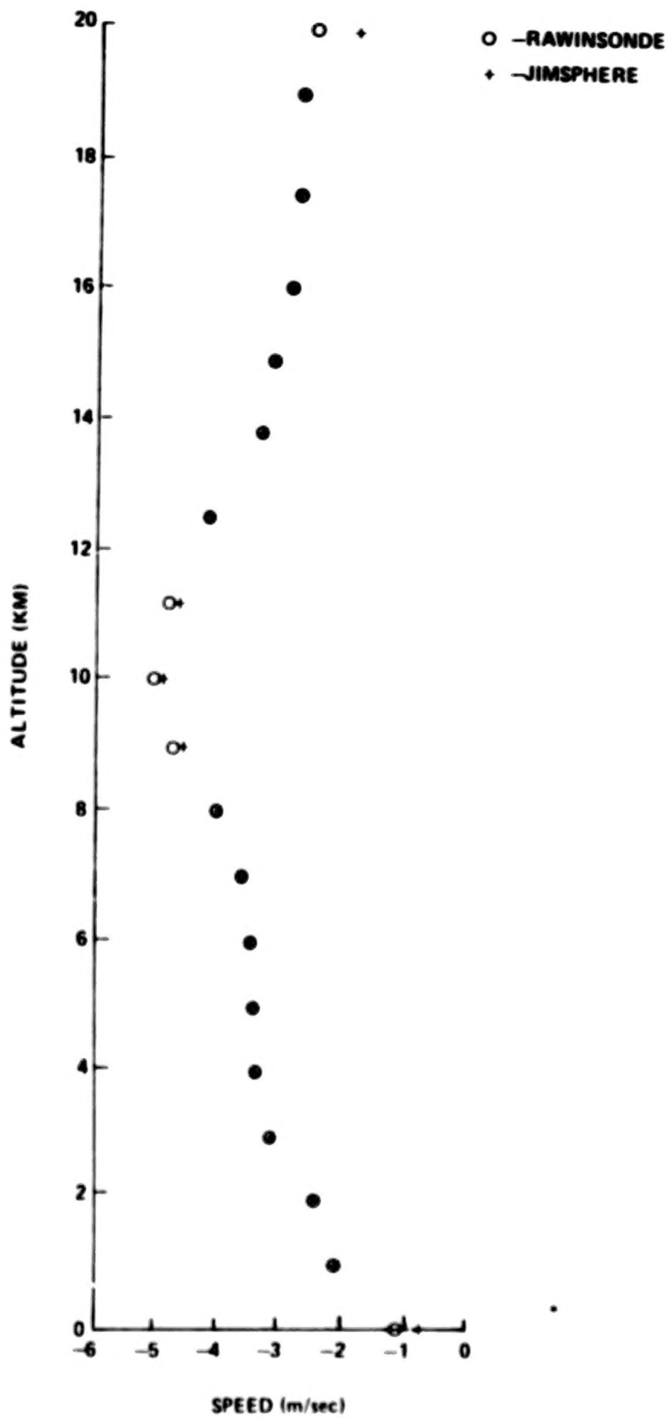

Figure 15. Comparison of the February mean meridional wind component profiles for the simulated Jimsphere and rawinsonde data.

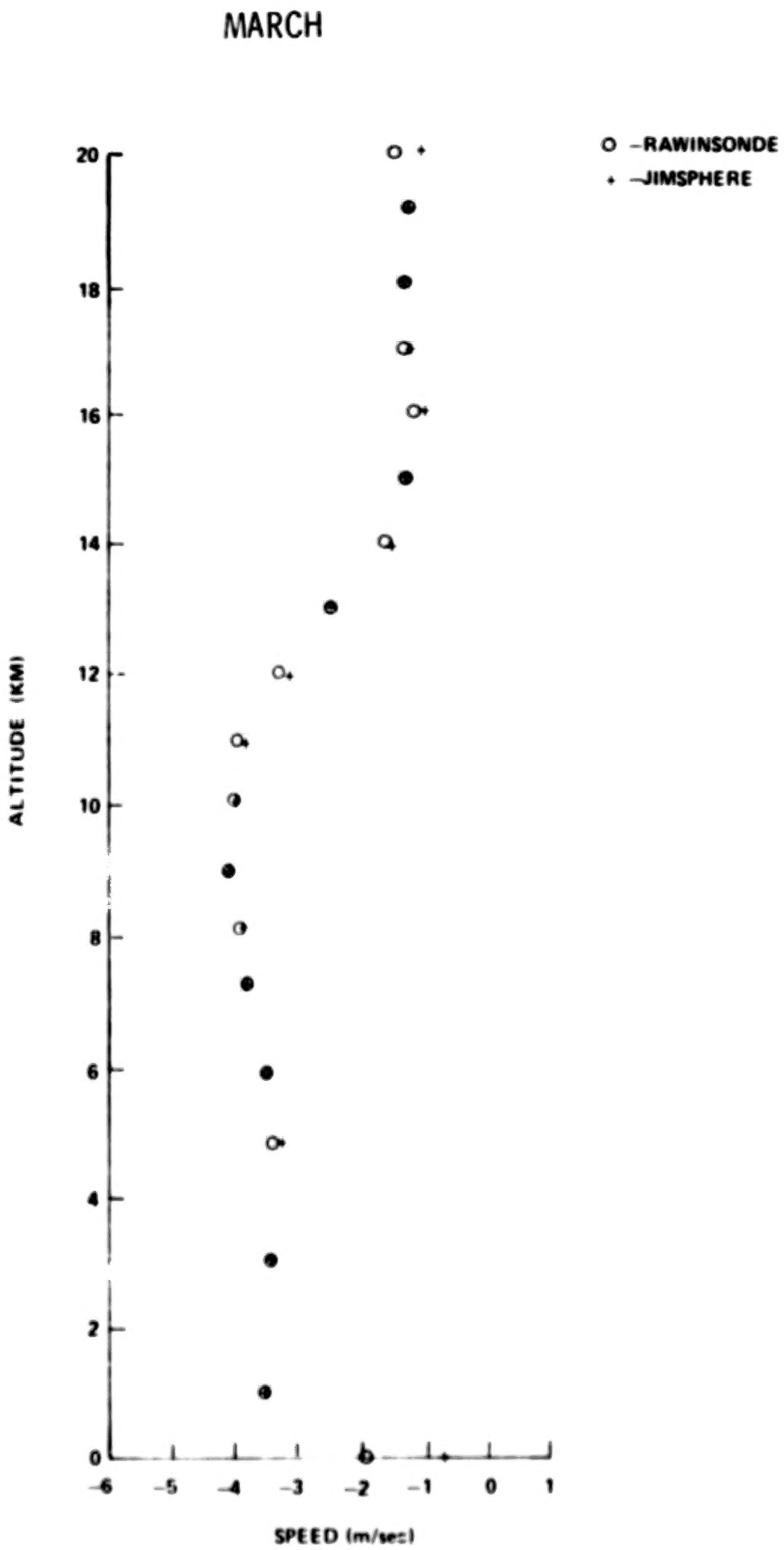

Figure 16. Comparison of the March mean meridional wind component profiles for the simulated Jimsphere and rawinsonde data.

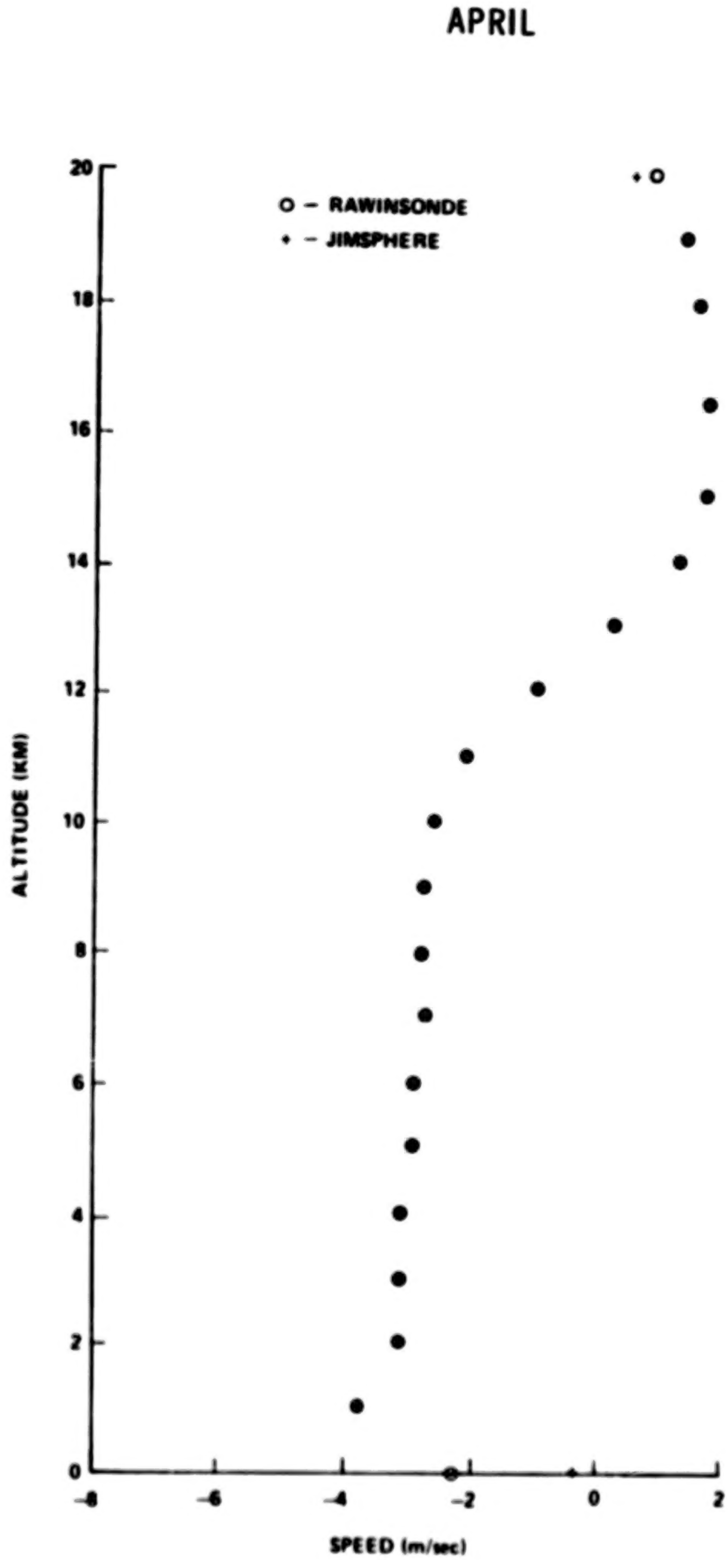

Figure 17. Comparison of the April mean meridional wind component profiles for the simulated Jimsphere and rawinsonde data.

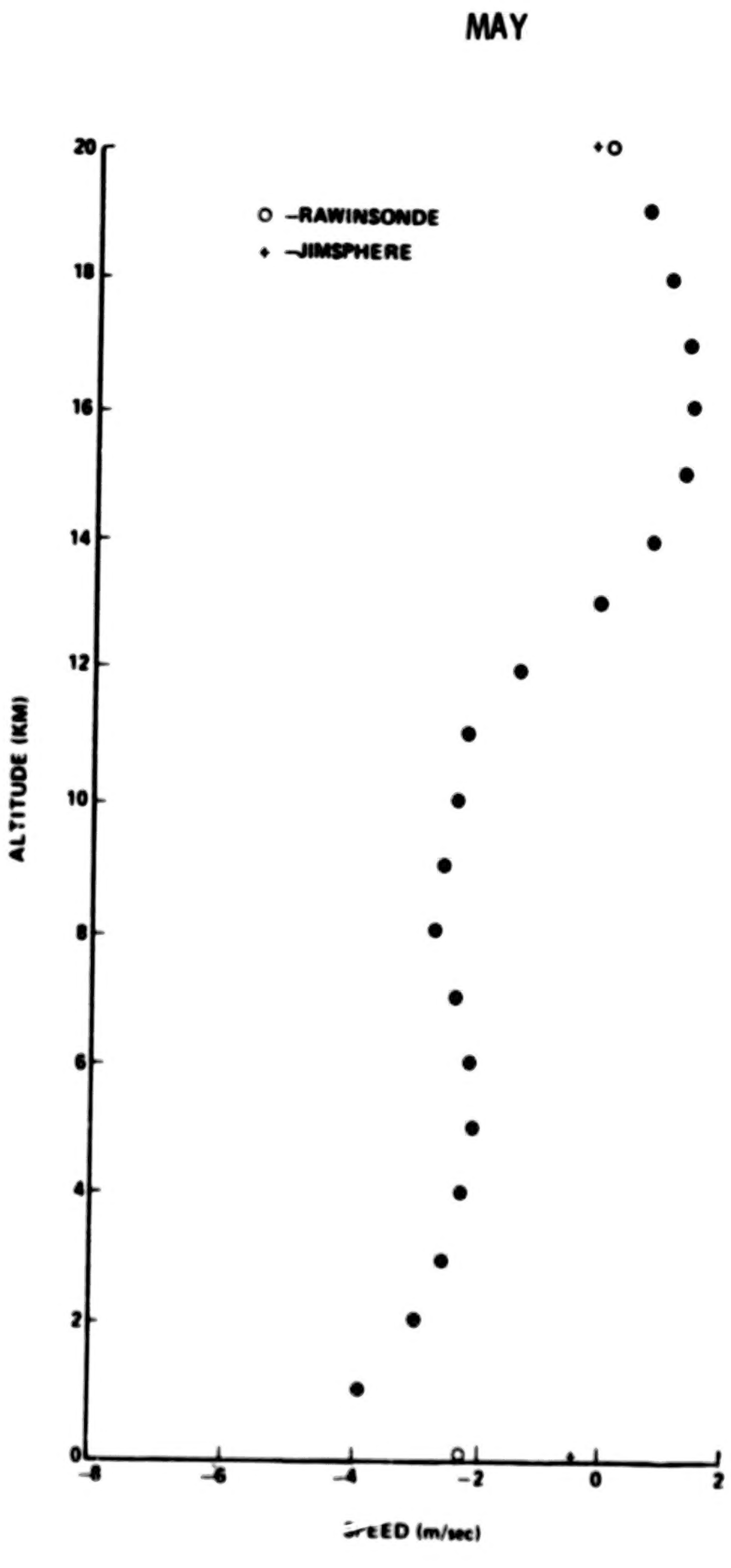

Figure 18. Comparison of the May mean meridional wind component profiles for the simulated Jimsphere and rawinsonde data.

JUNE

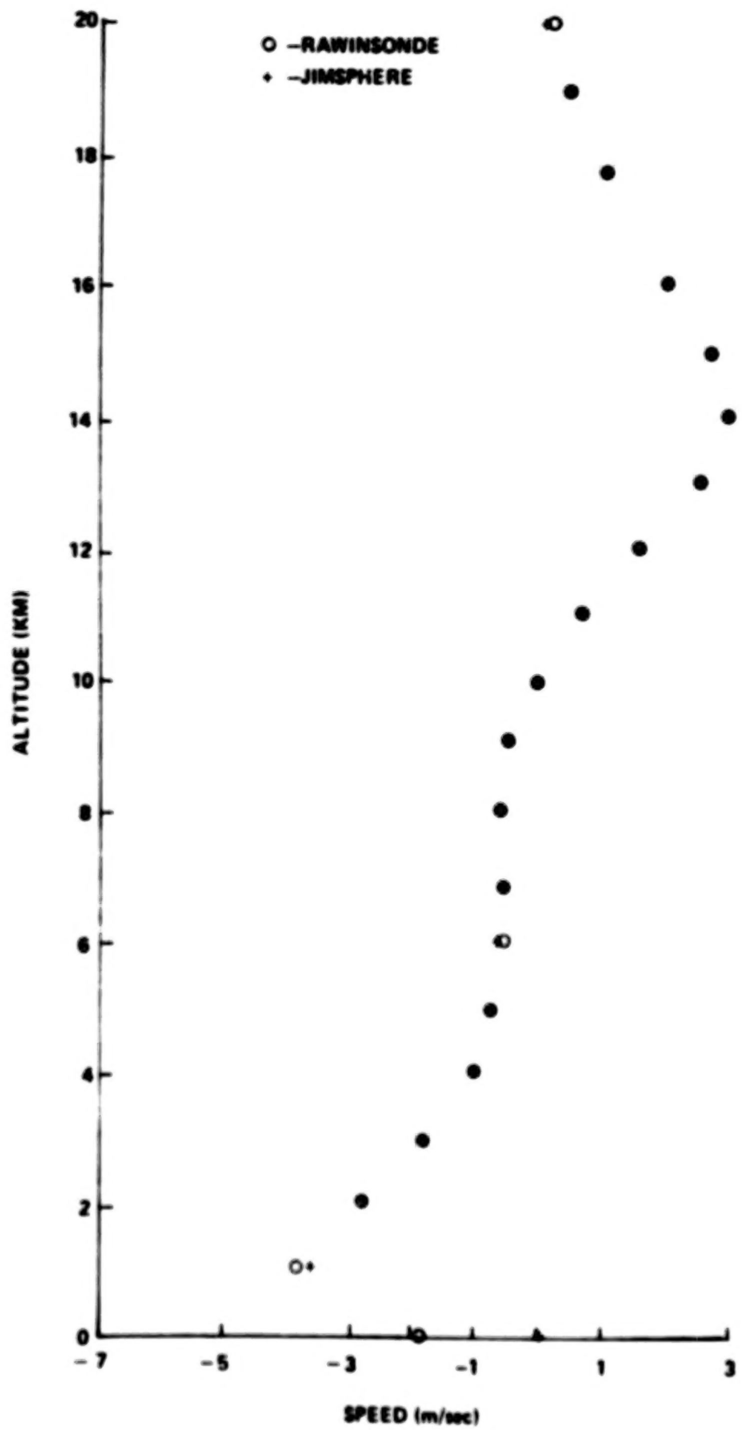

Figure 19. Comparison of the June mean meridional wind component profiles for the simulated Jimsphere and rawinsonde data.

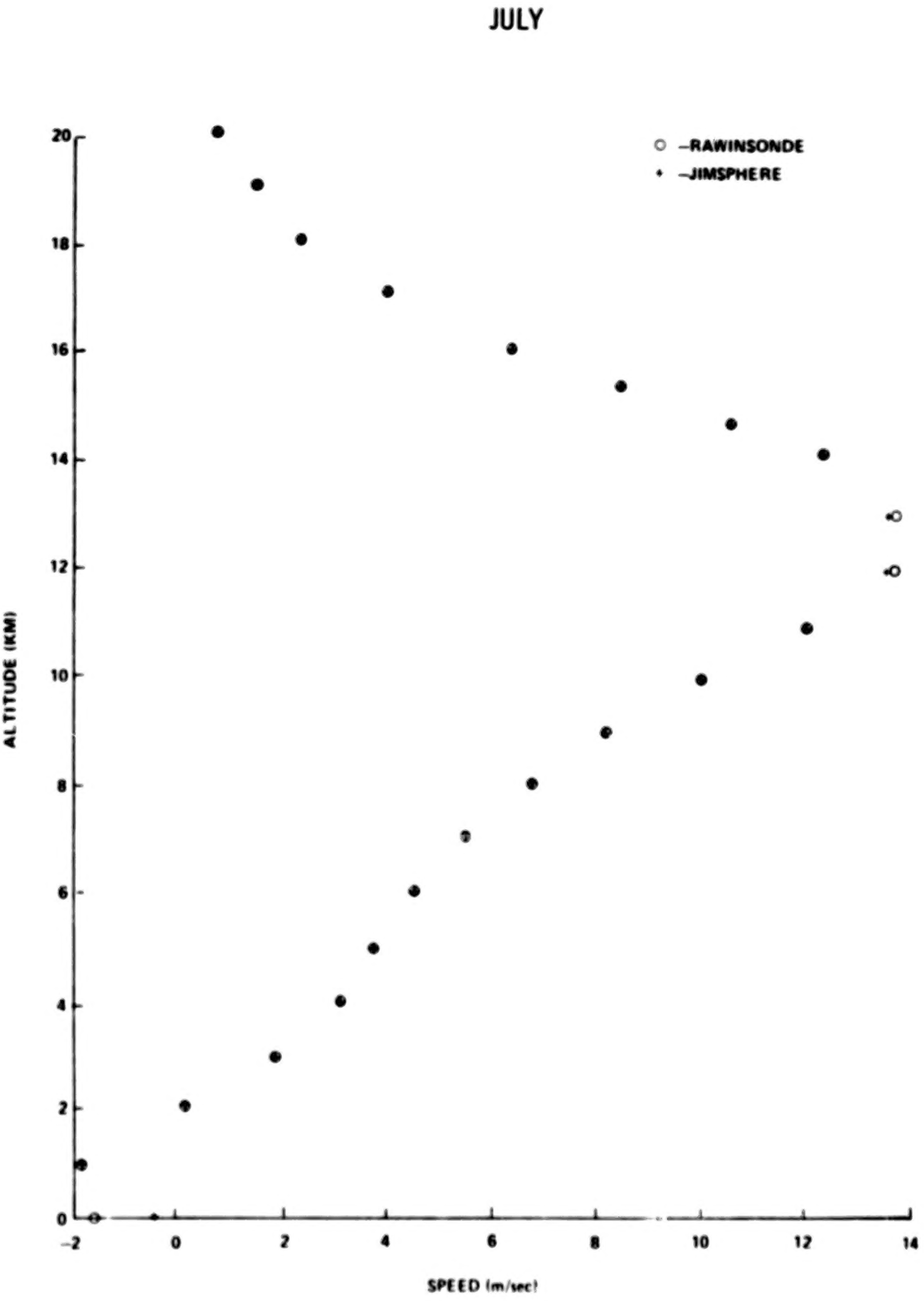

Figure 20. Comparison of the July mean meridional wind component profiles for the simulated Jimsphere and rawinsonde data.

AUGUST

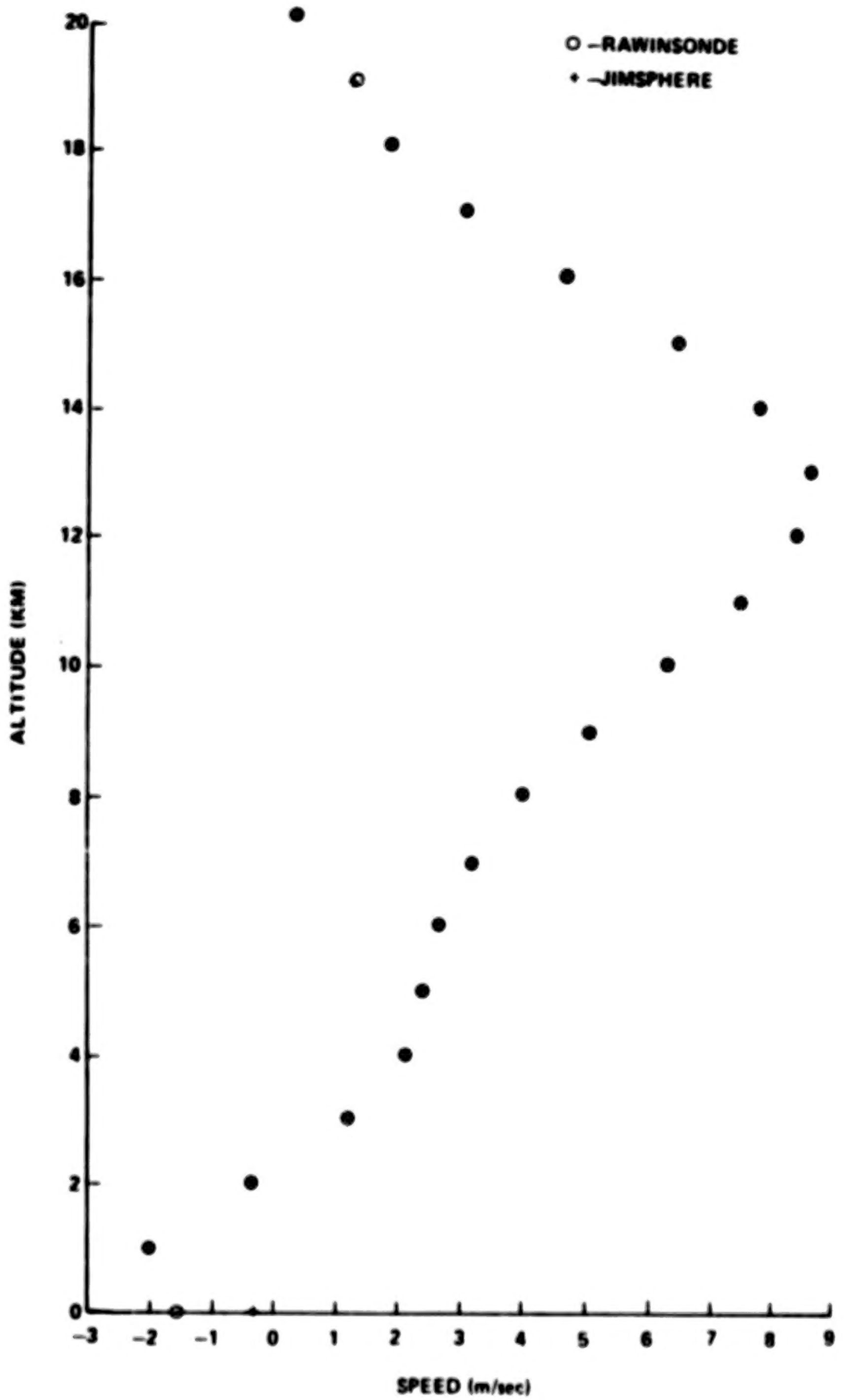

Figure 21. Comparison of the August mean meridional wind component profiles for the simulated Jimsphere and rawinsonde data.

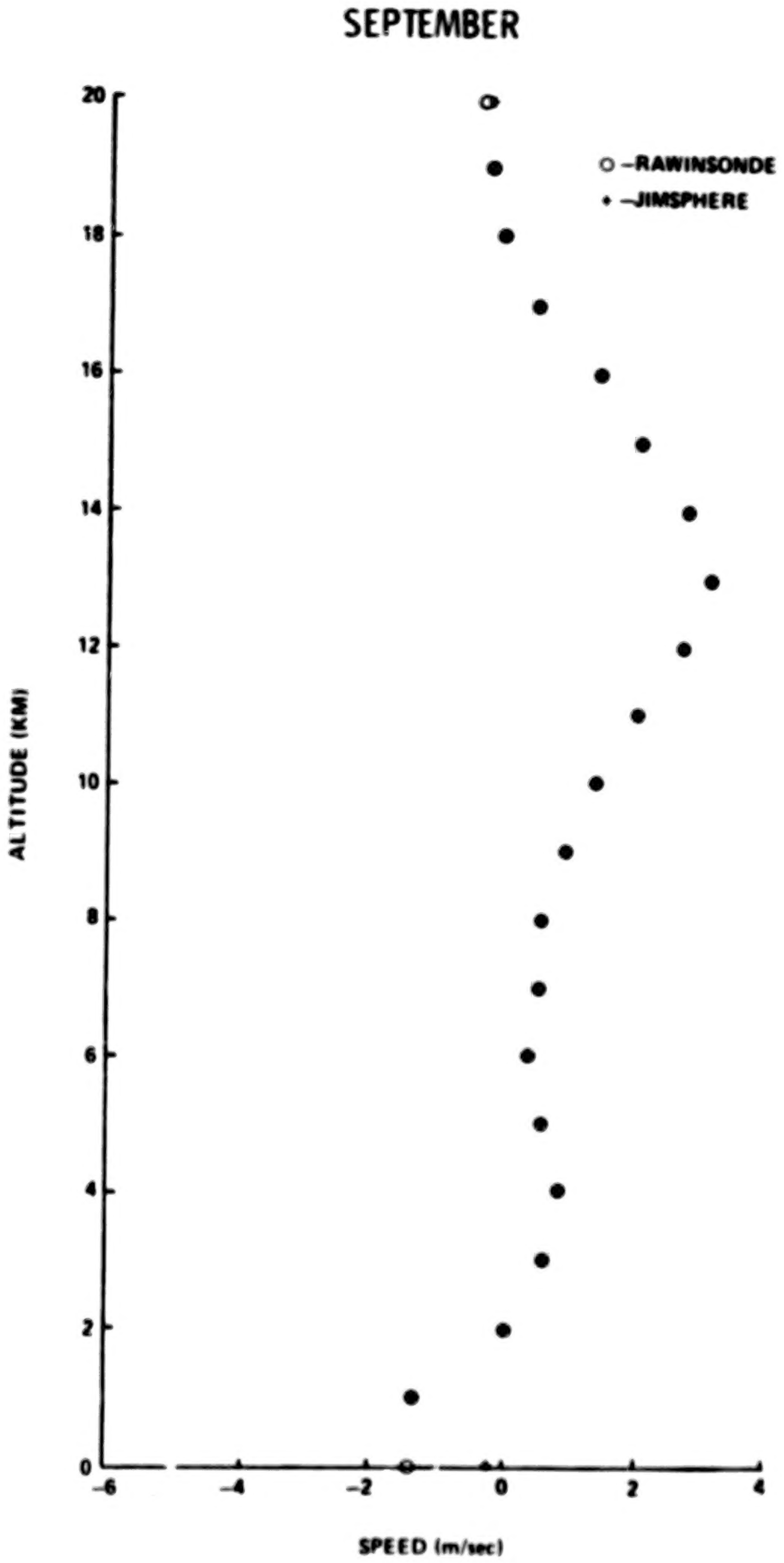

Figure 22. Comparison of the September mean meridional wind component profiles for the simulated Jimsphere and rawinsonde data.

OCTOBER

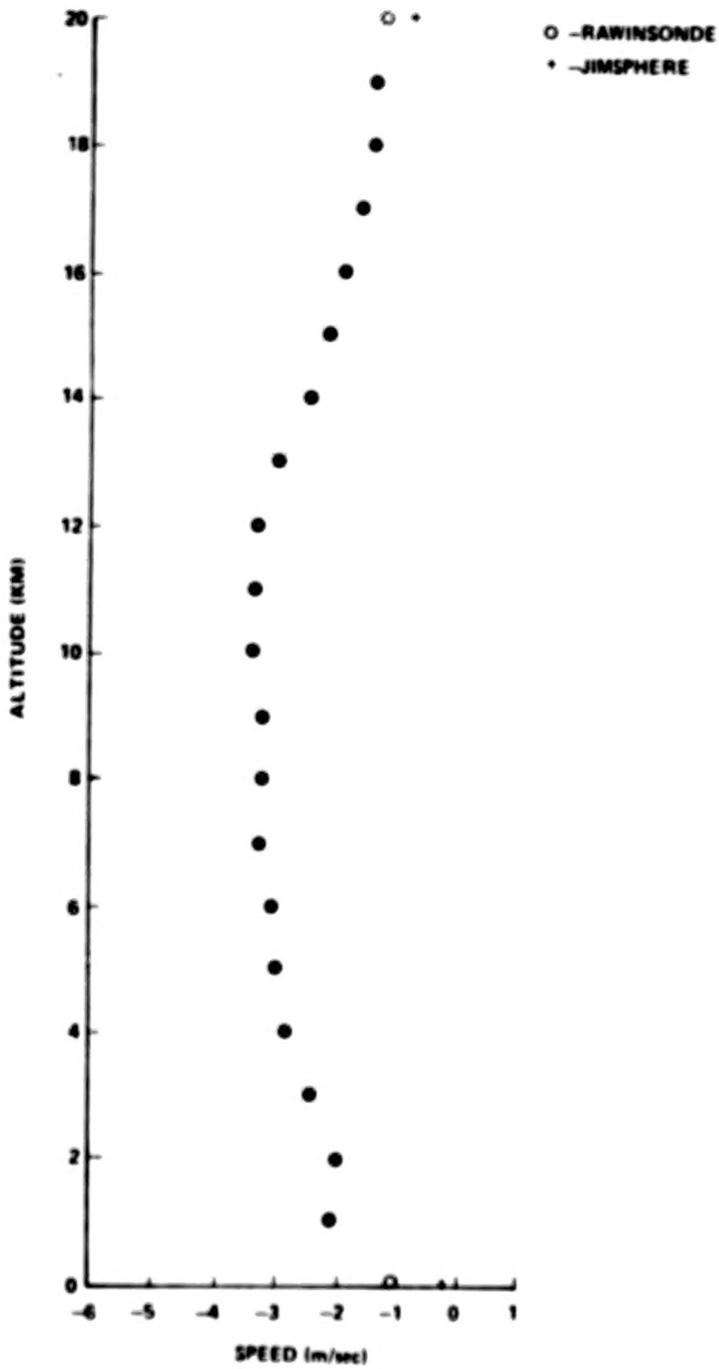

Figure 23. Comparison of the October mean meridional wind component profiles for the simulated Jimsphere and rawinsonde data.

NOVEMBER

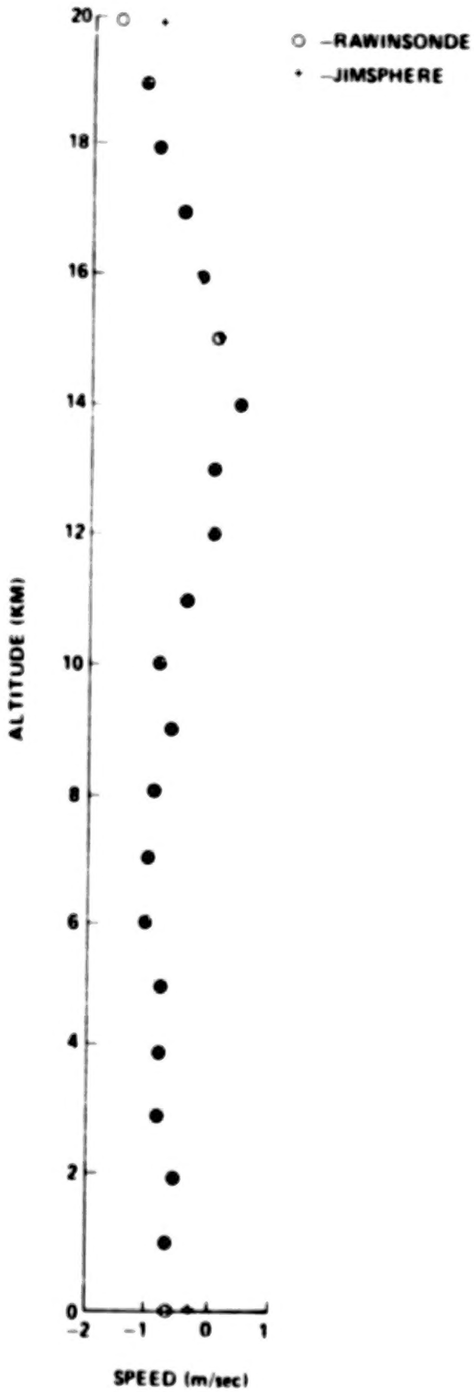

Figure 24. Comparison of the November mean meridional wind component profiles for the simulated Jimsphere and rawinsonde data.

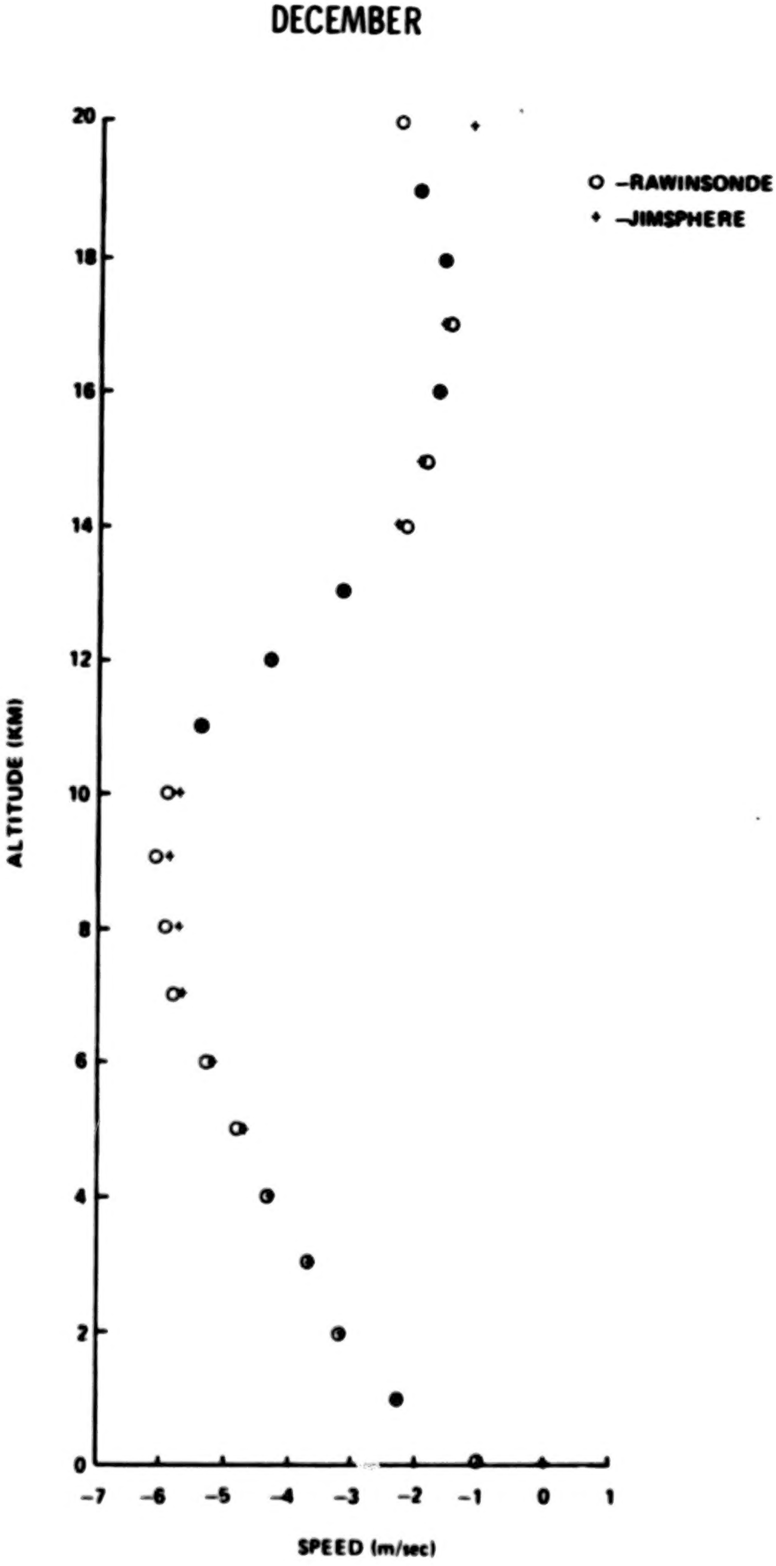

Figure 25. Comparison of the December mean meridional wind component profiles for the simulated Jimsphere and rawinsonde data.

profiles used in the computation of these means came from a population of twice daily serially complete rawinsonde data for Vandenberg Air Force Base. To show how the sample compared to the population, the mean of the population (6) is also plotted in Figures 2 through 25 for the wind components. From these illustrations it is seen that there is excellent agreement between the simulated Jimsphere mean wind components and the rawinsonde data except at the surface (0.0 km) and at 20 kilometers. The difference between the profiles at the surface and at 20 kilometers is a result of how the end points were treated in the computer program. The values at the surface and 20 kilometers were to be the same as those at 25 meters and 19,975 meters, respectively. However, this fact was inadvertently overlooked in developing the computer program since this was considered to be a minor problem and not worthy of the effort necessary to eliminate or remove it by reprogramming the reduction scheme. It should be indicated that this belief was strengthened by the fact that the profile component values at 25 meters and at 19,975 meters altitude were in close agreement with the desired values.

As noted in Chapter II, the wind gust profiles were obtained by utilizing the Kennedy Space Center Jimsphere wind profile data. This was accomplished by a utilization of Equations 2.6 through 2.13 and was fully discussed in the preceding chapter. The wind gust data are accurate and have been discussed extensively in various publications, for

example, see Scoggins (1), Susko and Vaughan (2), and Camp and Vaughan (5).

An indication of the agreement between the wind gust data of the simulated Jimsphere data and the rawinsonde data can be seen in Figures 26 through 37 for the zonal wind component and in Figures 38 through 49 for the meridional wind component. The standard deviation of the simulated Jimsphere wind component data was computed by

$$\sigma_u = \left[\frac{1}{N} \sum_{k=1}^{N} (\bar{u} - u)^2\right]^{1/2} \tag{3.2}$$

and

$$\sigma_v = \left[\frac{1}{N} \sum_{k=1}^{N} (\bar{v} - v)^2\right]^{1/2} \tag{3.3}$$

where $\bar{u}$ and $\bar{v}$ are the values obtained for the components by use of Equation 3.1. The values of u and v to be used are the ones obtained by use of Equations 2.14 and 2.15 for the simulated Jimsphere data and from Equations 2.1 and 2.2 for the rawinsonde data. The value of N is as indicated earlier for Equation 3.1.

Another check which was made relative to the quality of the simulated Jimsphere data was that of computing and comparing the correlation coefficients between the zonal and meridional components for the simulated data and the rawinsonde data. The correlation coefficients are determined by

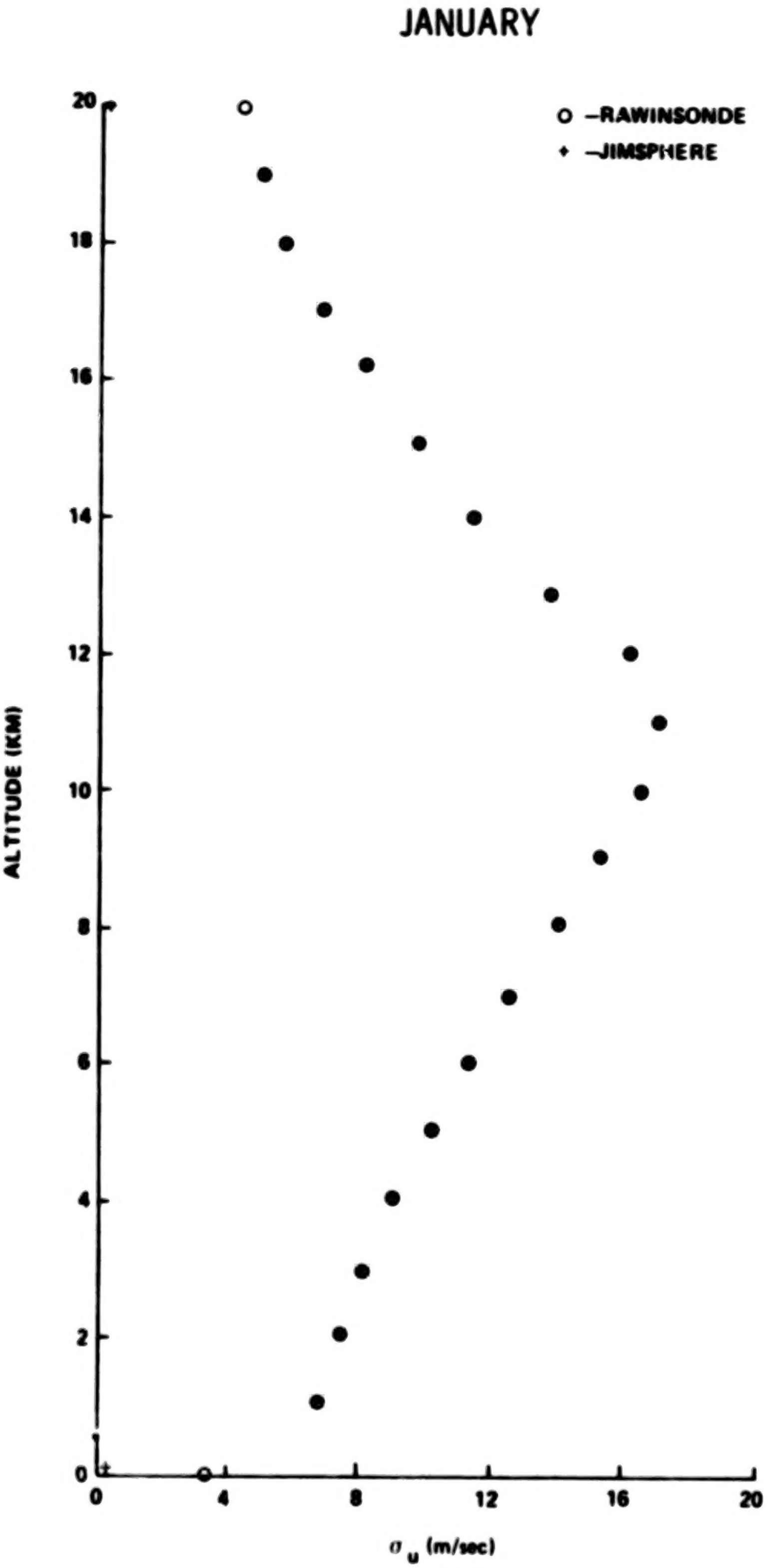

Figure 26. Comparison of the standard deviation for the January zonal wind component profiles for the simulated Jimsphere and rawindonde data.

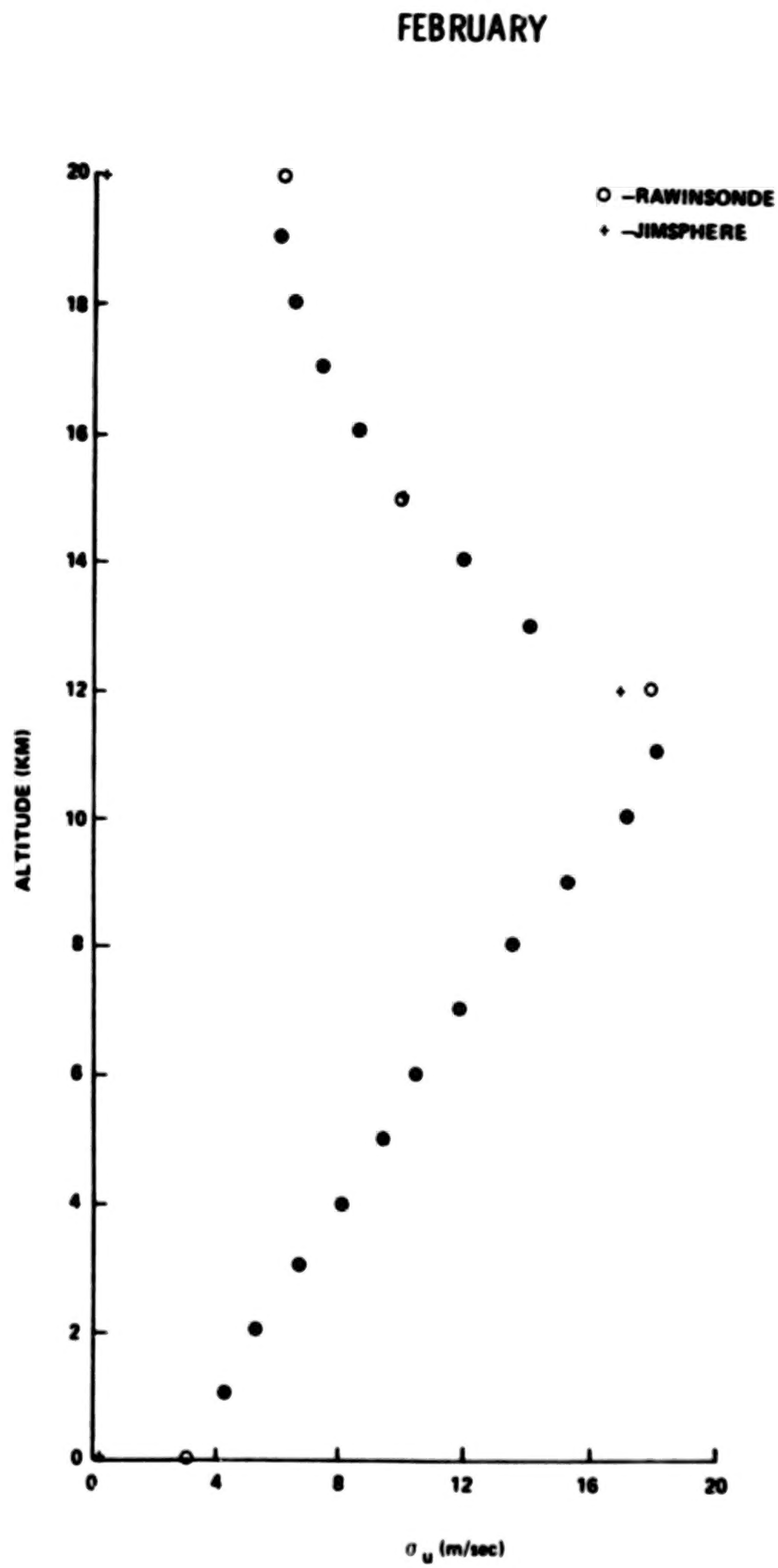

Figure 27. Comparison of the standard deviation for the February zonal wind component profiles for the simulated Jimsphere and rawinsonde data.

MARCH

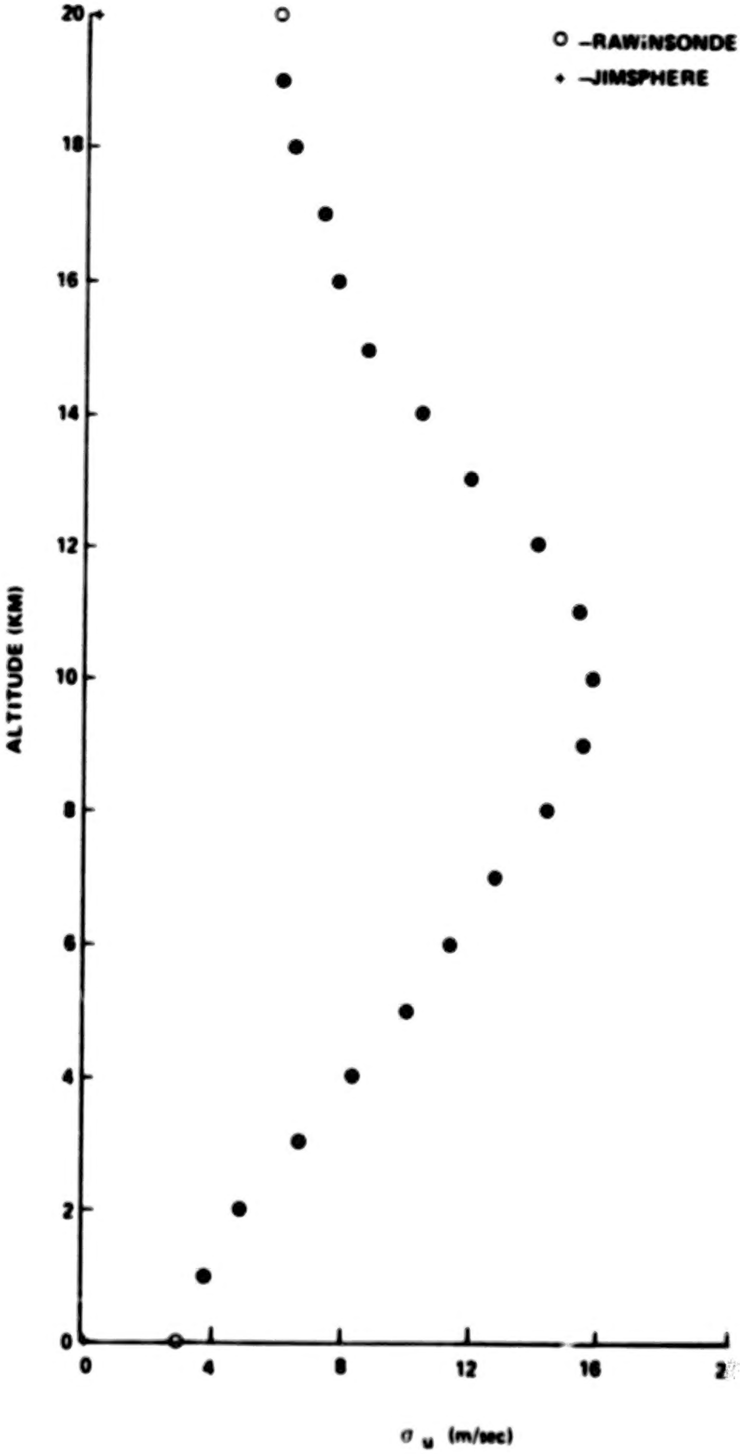

Figure 28. Comparison of the standard deviation for the March zonal wind component profiles for the simulated Jimsphere and rawinsonde data.

APRIL

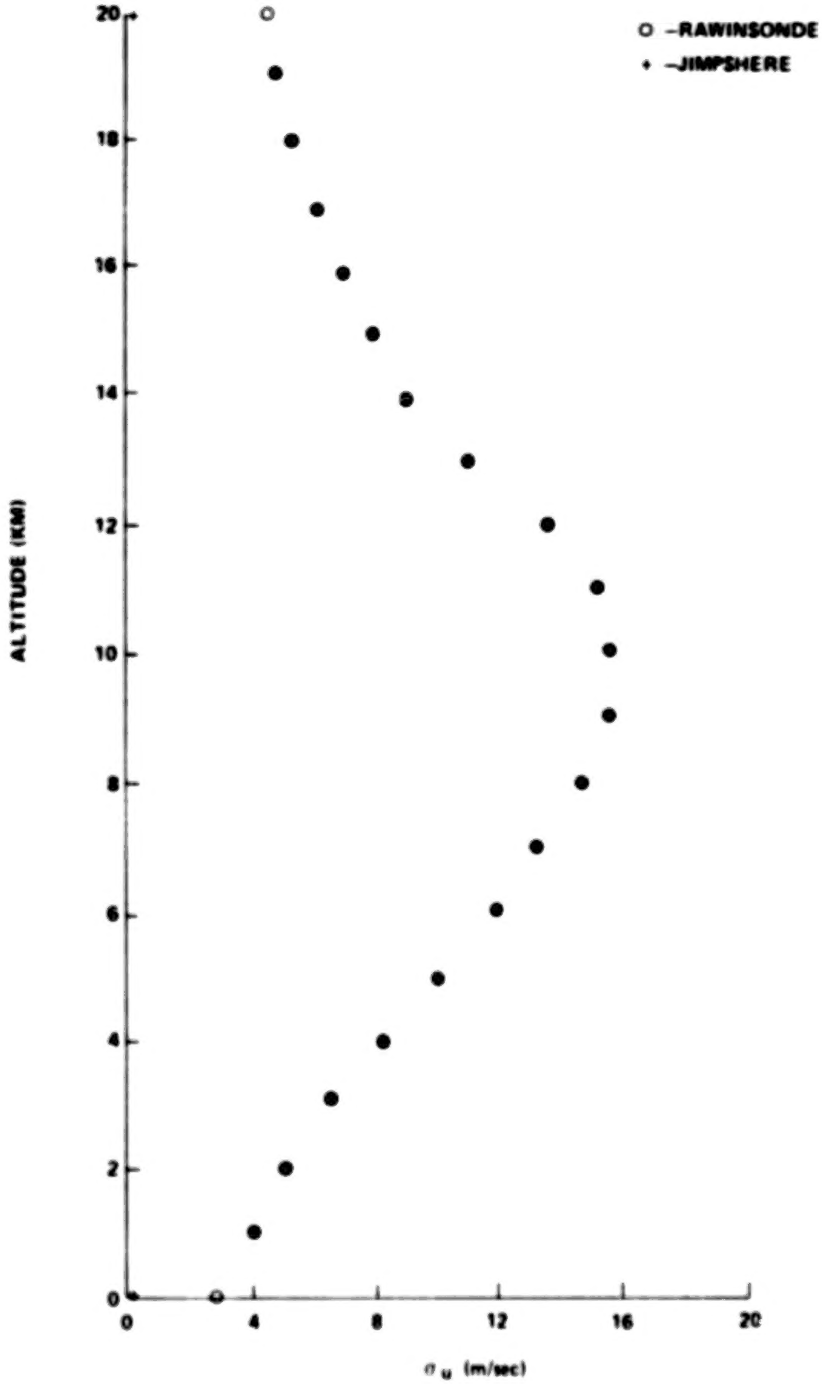

Figure 29. Comparison of the standard deviation for the April zonal wind component profiles for the simulated Jimsphere and rawinsonde data.

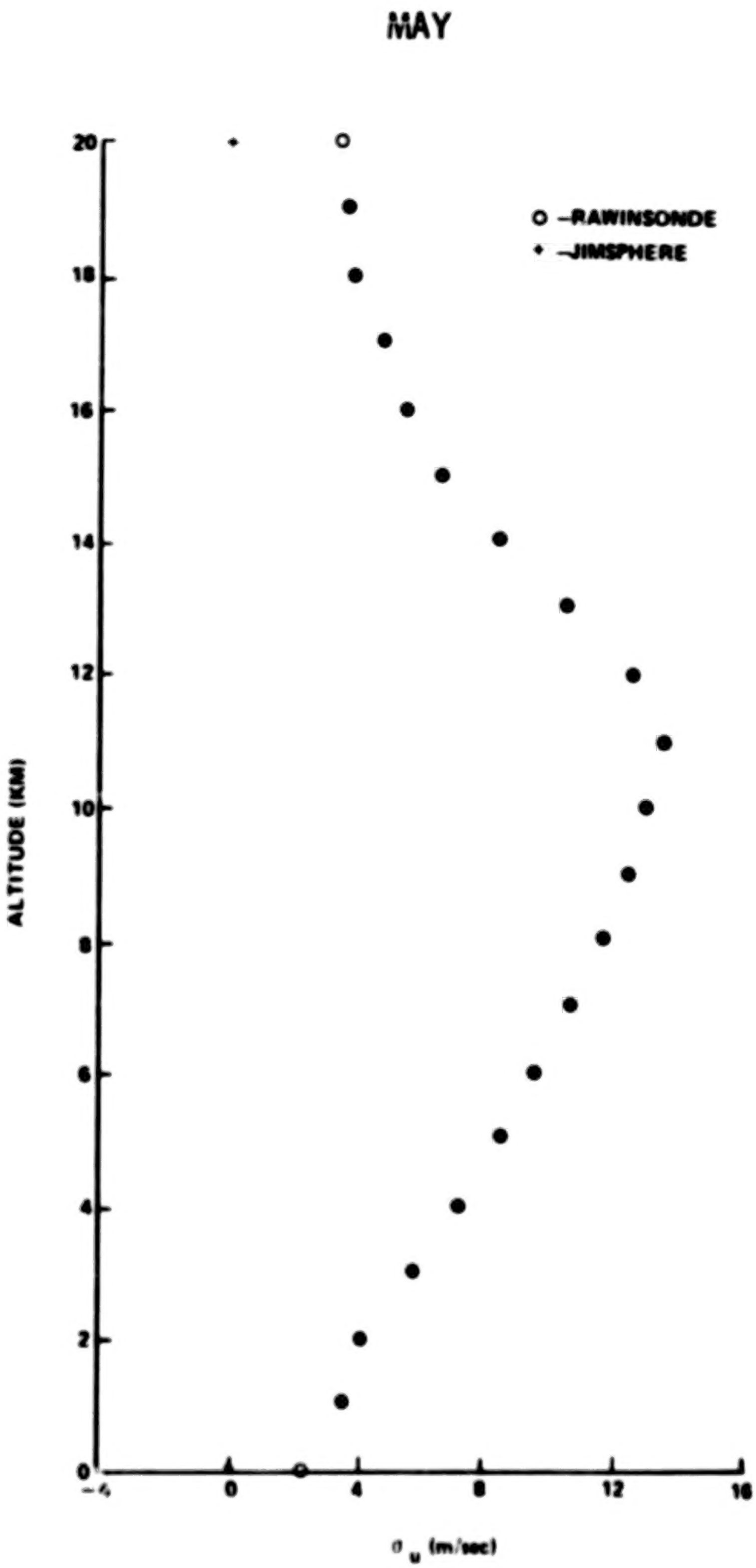

Figure 30. Comparison of the standard deviation for the May zonal wind component profiles for the simulated Jimsphere and rawinsonde data.

JUNE

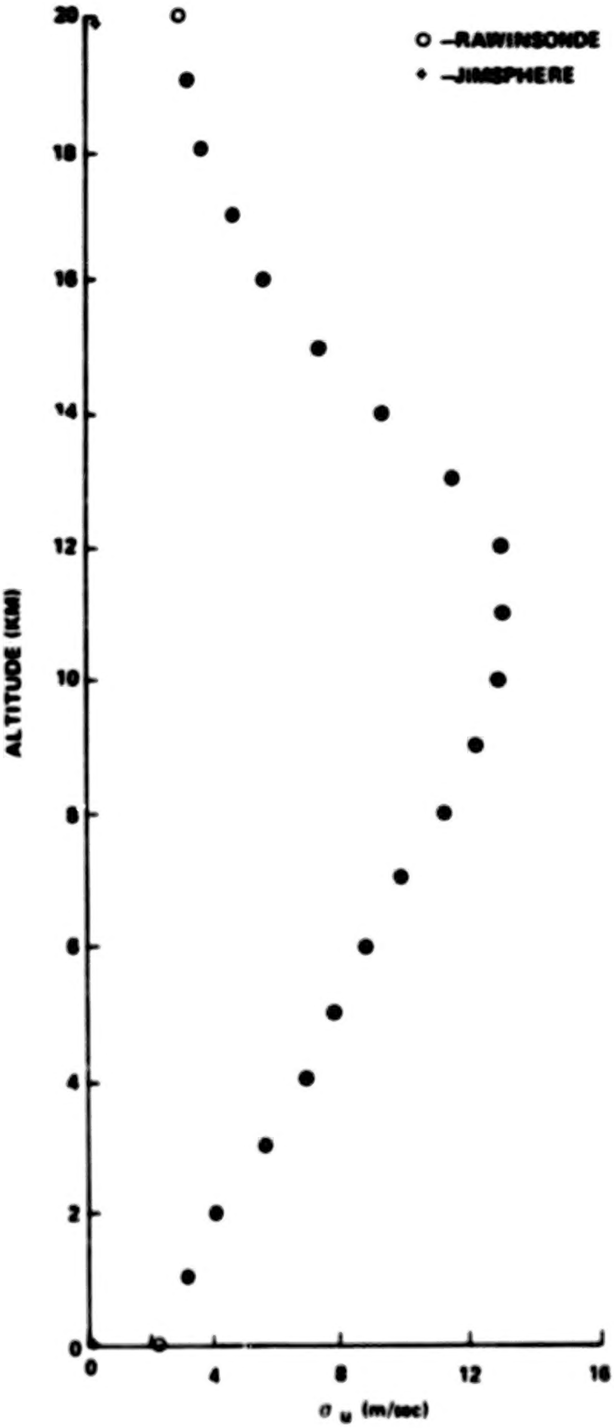

Figure 31. Comparison of the standard deviation for the June zonal wind component profiles for the simulated Jimsphere and rawinsonde data.

JULY

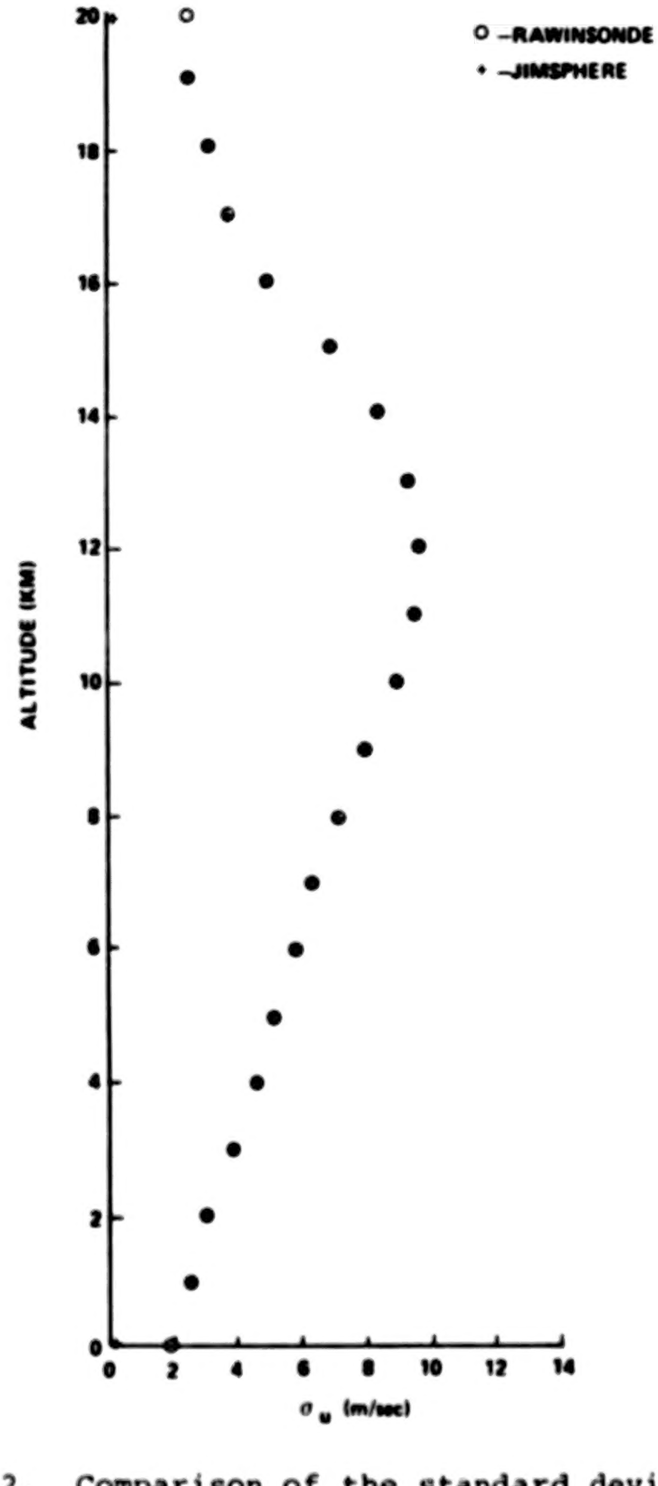

Figure 32. Comparison of the standard deviation for the July zonal wind component profiles for the simulated Jimsphere and rawinsonde data.

AUGUST

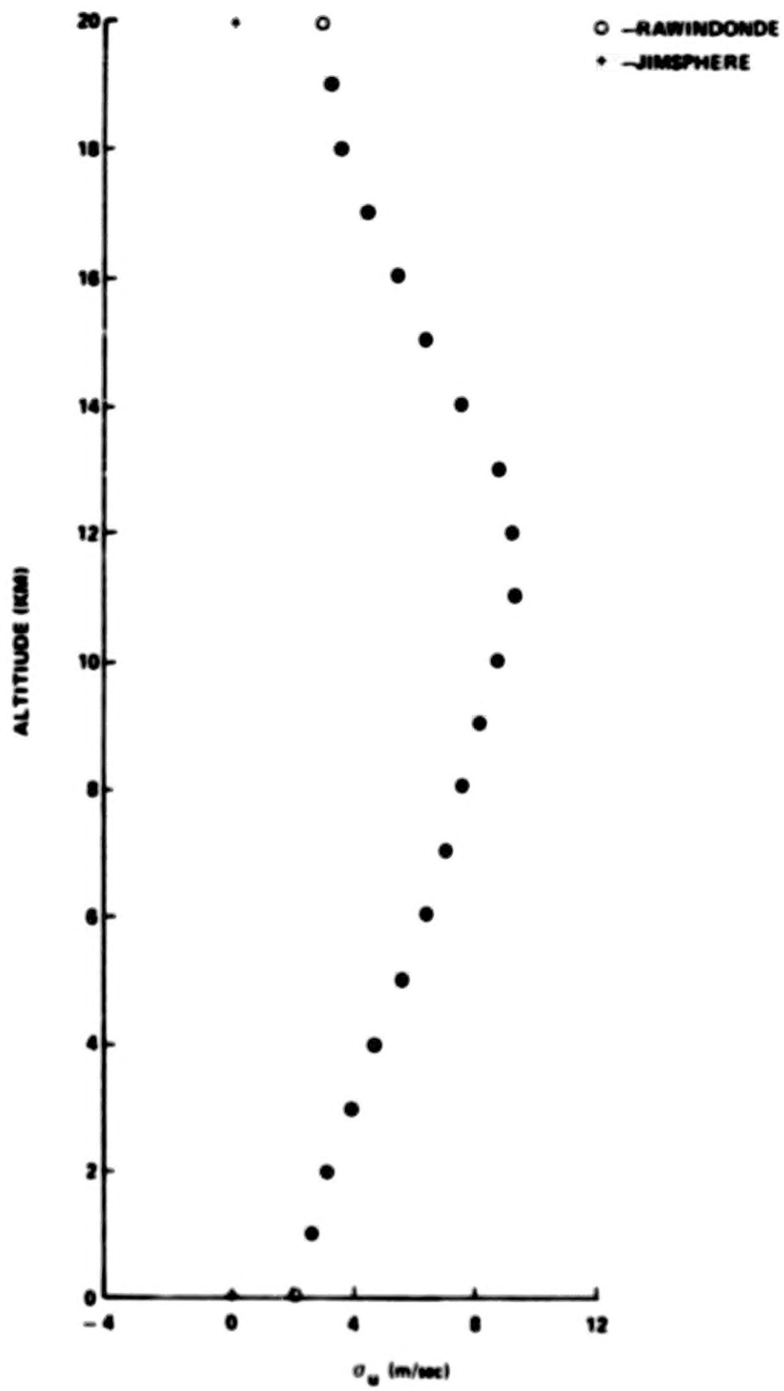

Figure 33. Comparison of the standard deviation for the August zonal wind component profiles for the simulated Jimsphere and rawinsonde data.

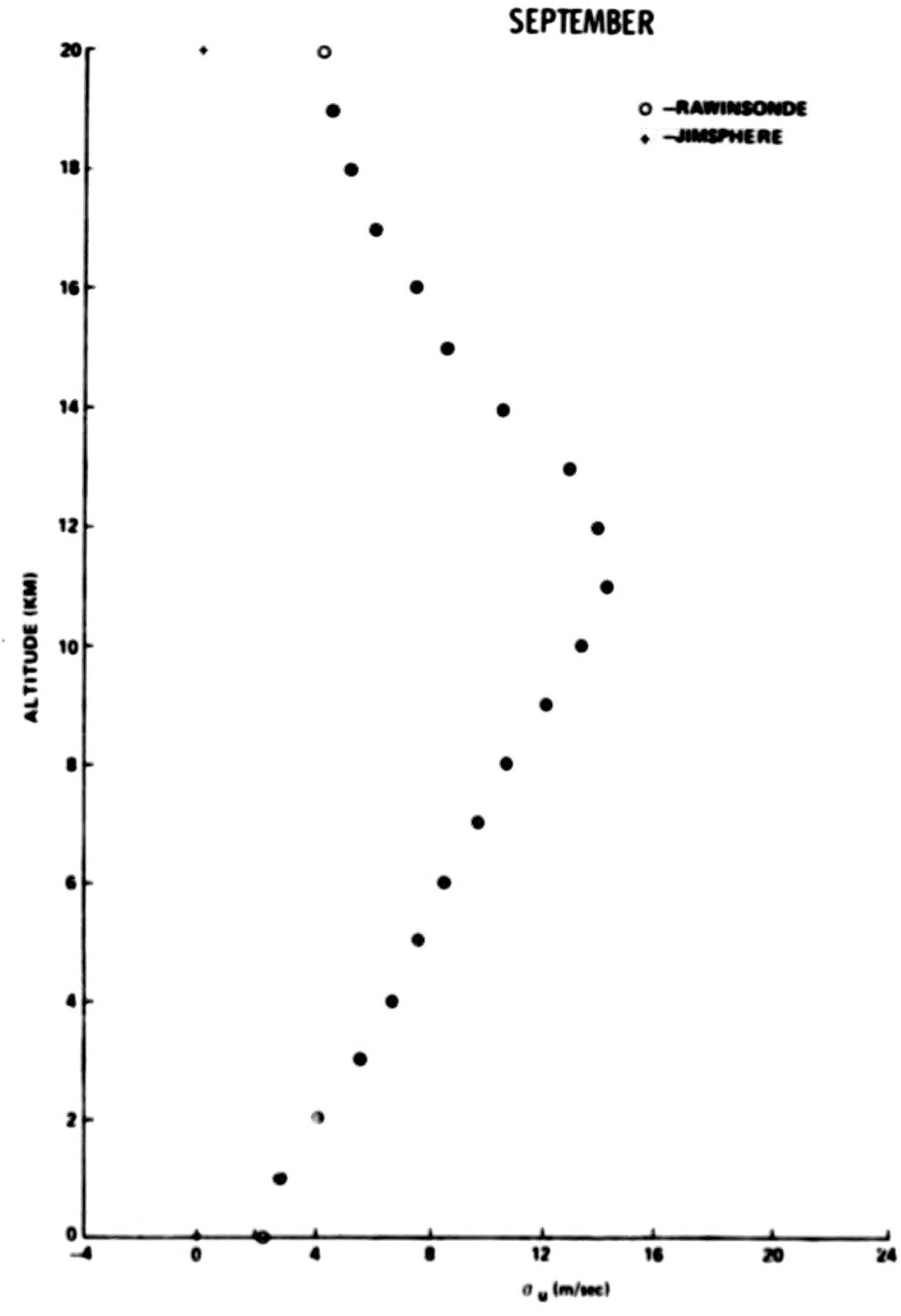

Figure 34. Comparison of the standard deviation for the September zonal wind component profiles for the simulated Jimsphere and rawinsonde data.

OCTOBER

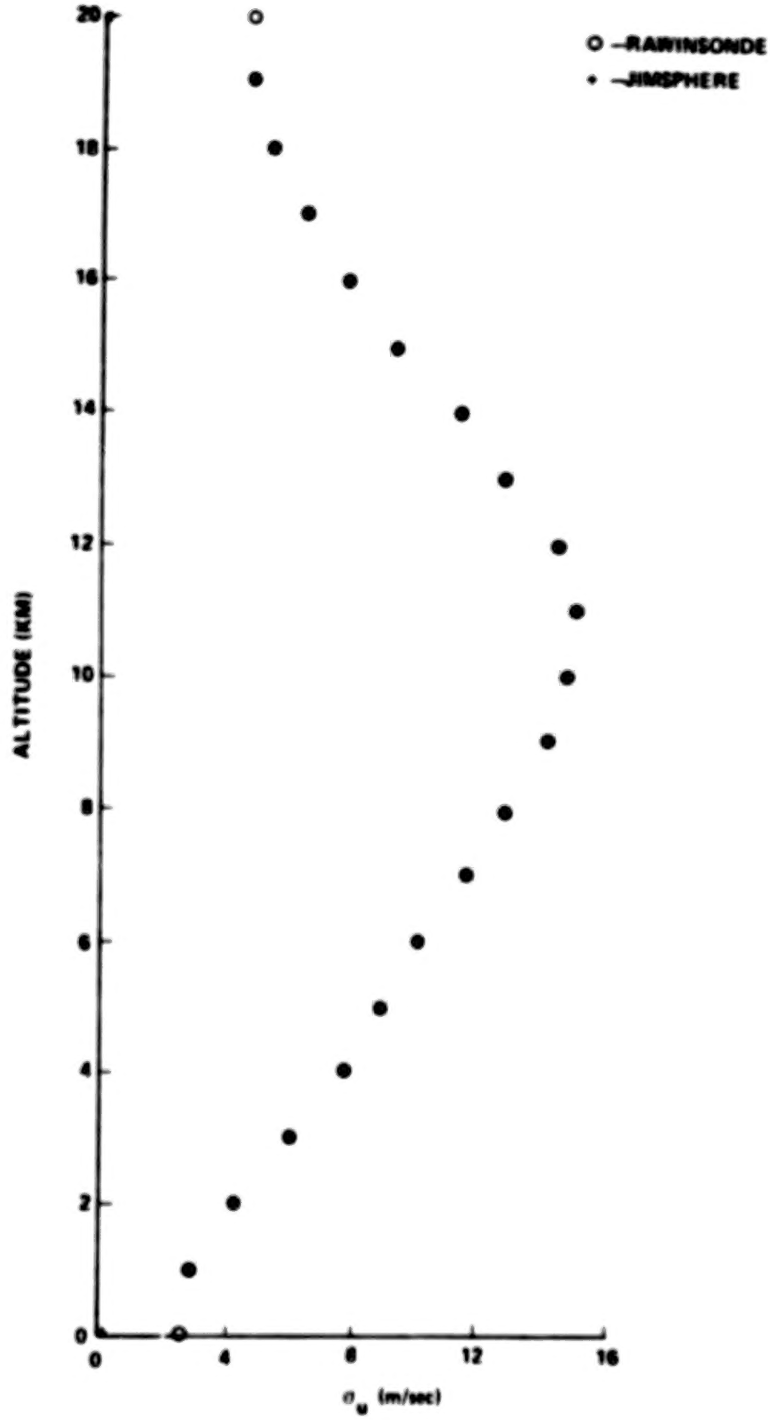

Figure 35. Comparison of the standard deviation for the October zonal wind component profiles for the simulated Jimsphere and rawinsonde data.

NOVEMBER

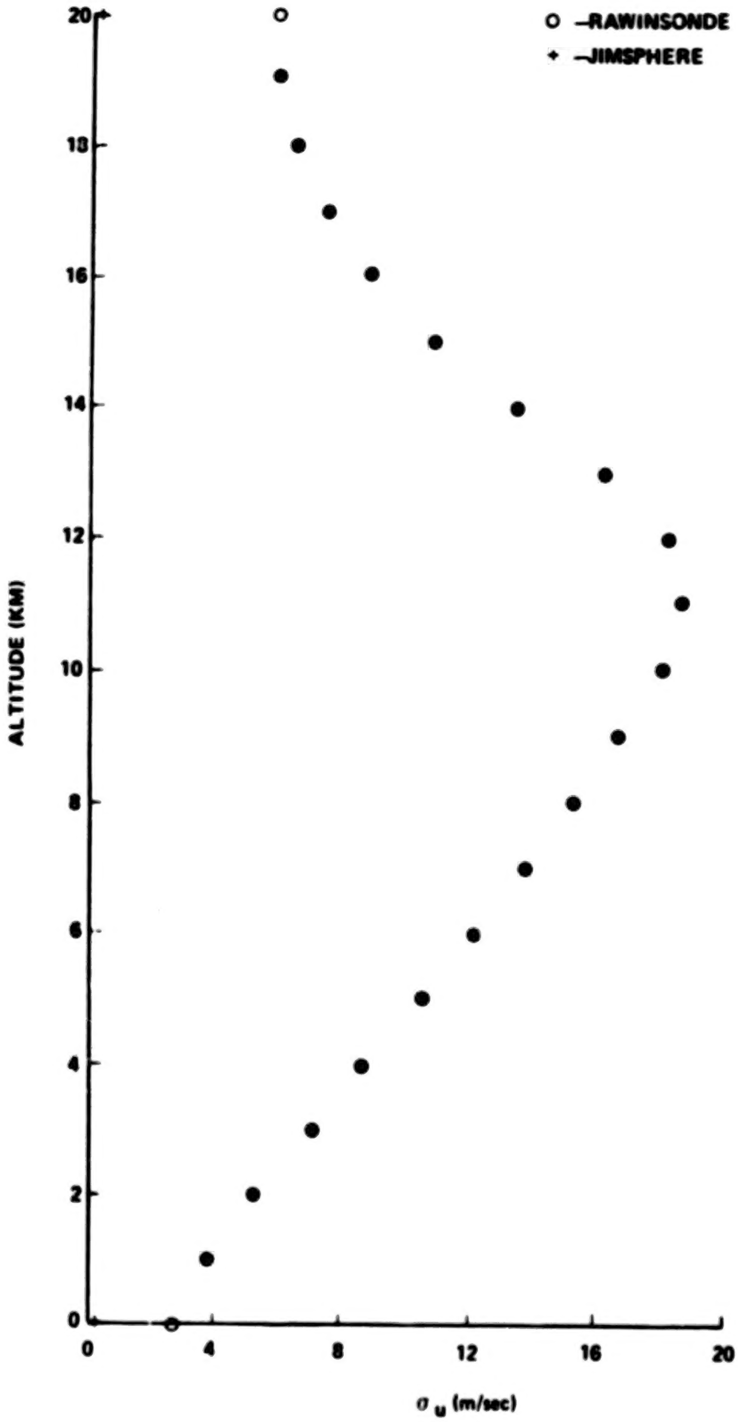

Figure 36. Comparison of the standard deviation for the November zonal wind component profiles for the simulated Jimsphere and rawinsonde data.

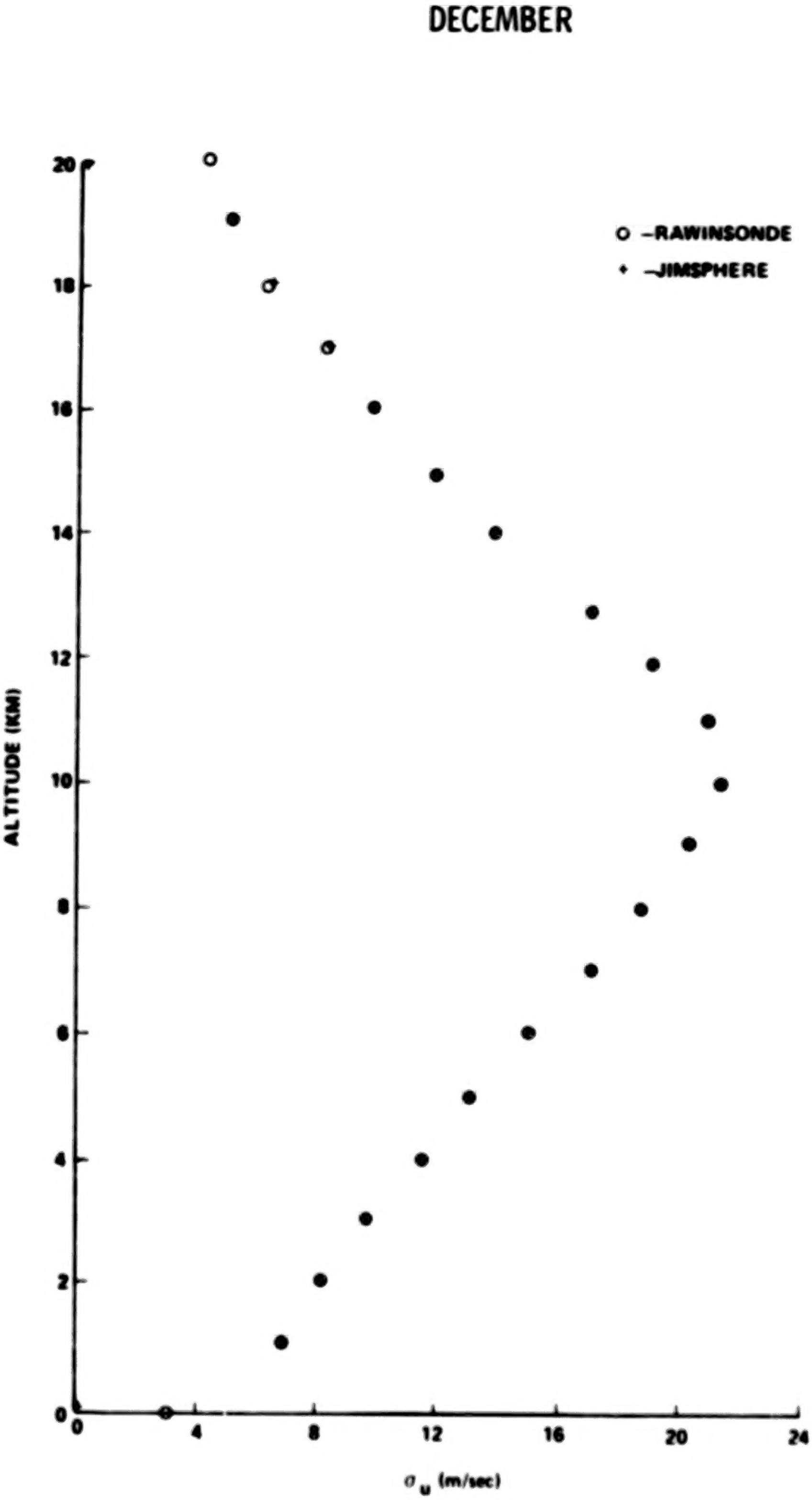

Figure 37. Comparison of the standard deviation for the December zonal wind component profiles for the simulated Jimsphere and rawinsonde data.

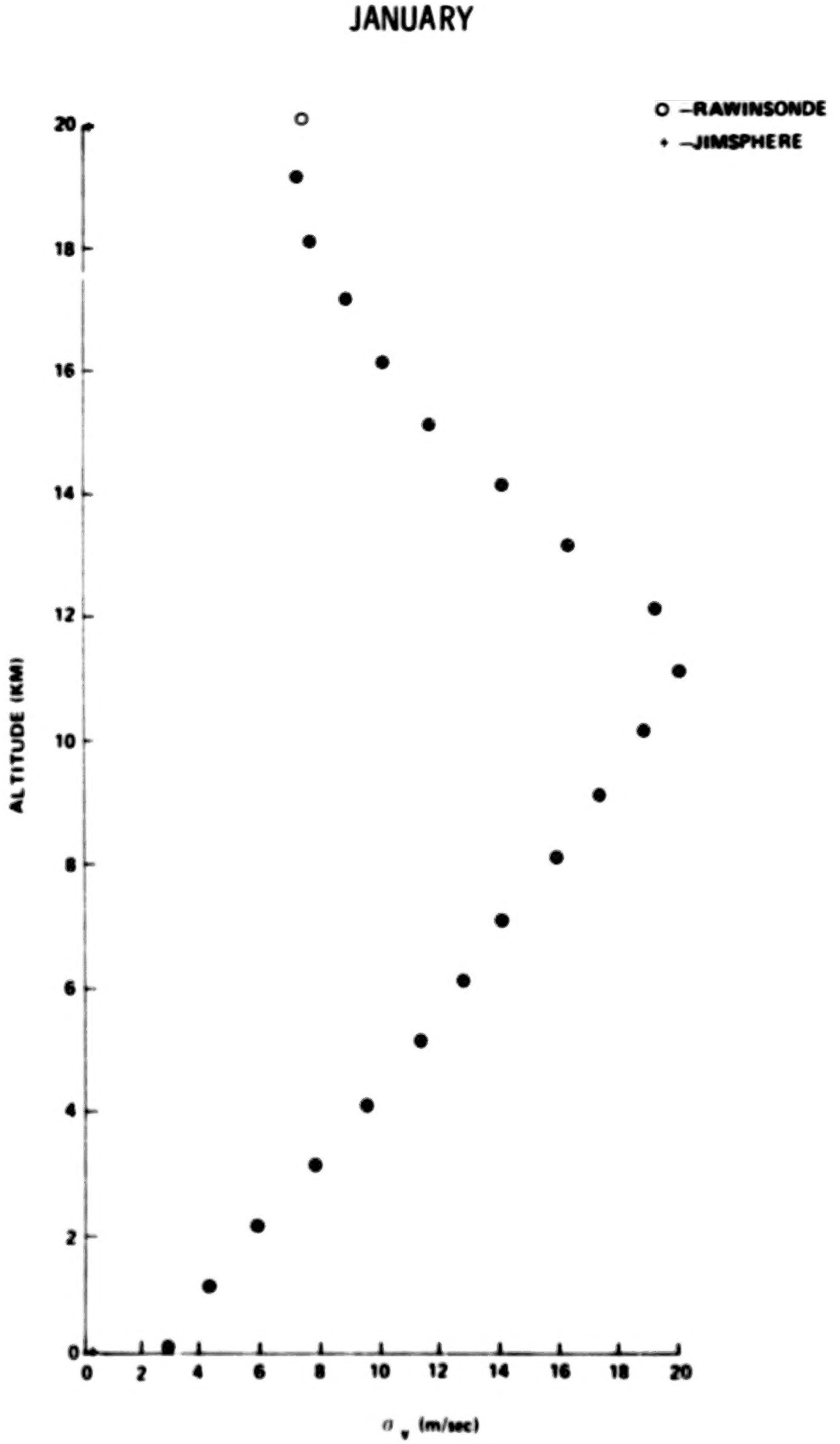

Figure 38. Comparison of the standard deviation for the January meridional wind component profiles for the simulated Jimsphere and rawinsonde data.

FEBRUARY

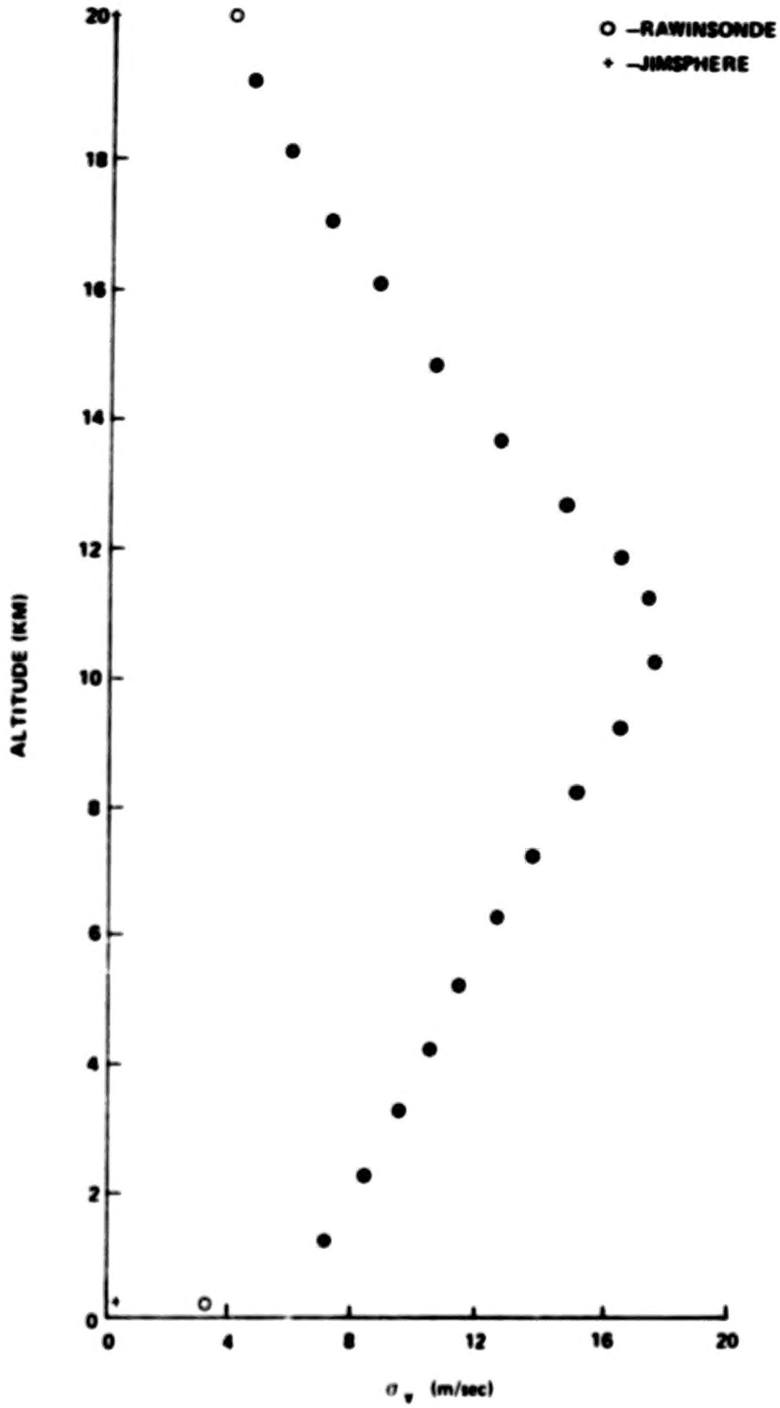

Figure 39. Comparison of the standard deviation for the February meridional wind component profiles for the simulated Jimsphere and rawinsonde data.

MARCH

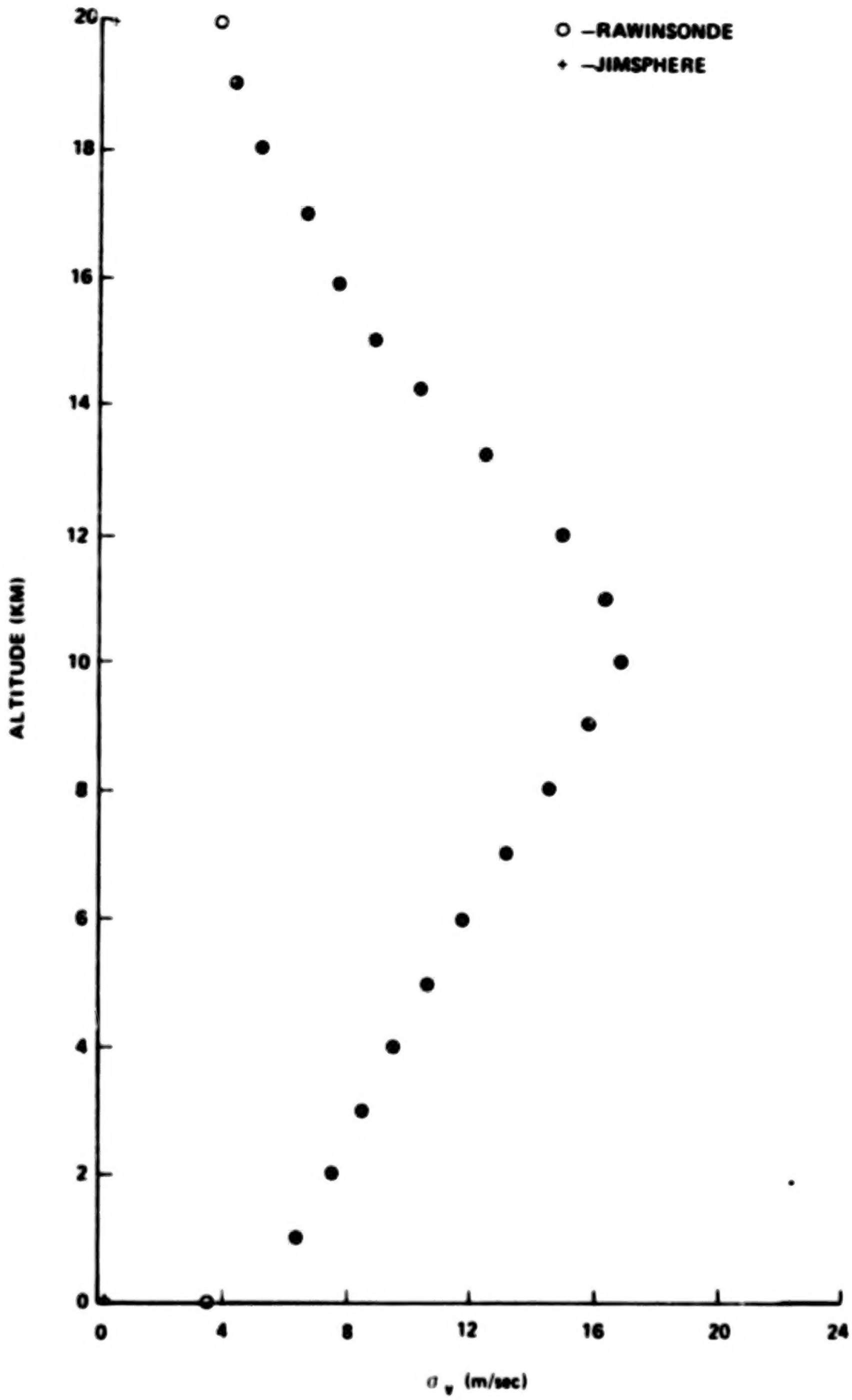

Figure 40. Comparison of the standard deviation for the March meridional wind component profiles for the simulated Jimsphere and rawinsonde data.

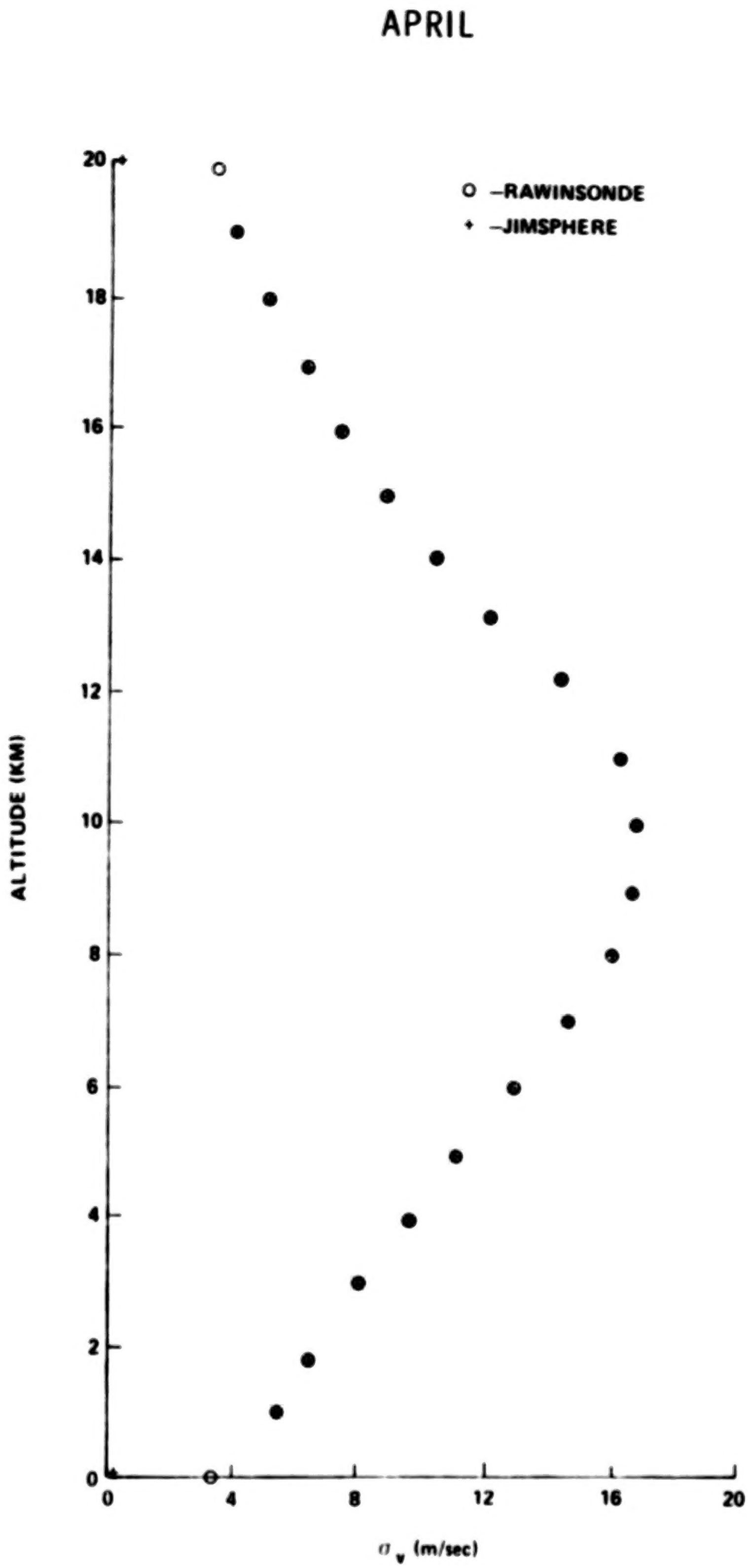

Figure 41. Comparison of the standard deviation for the April meridional wind component profiles for the simulated Jimsphere and rawinsonde data.

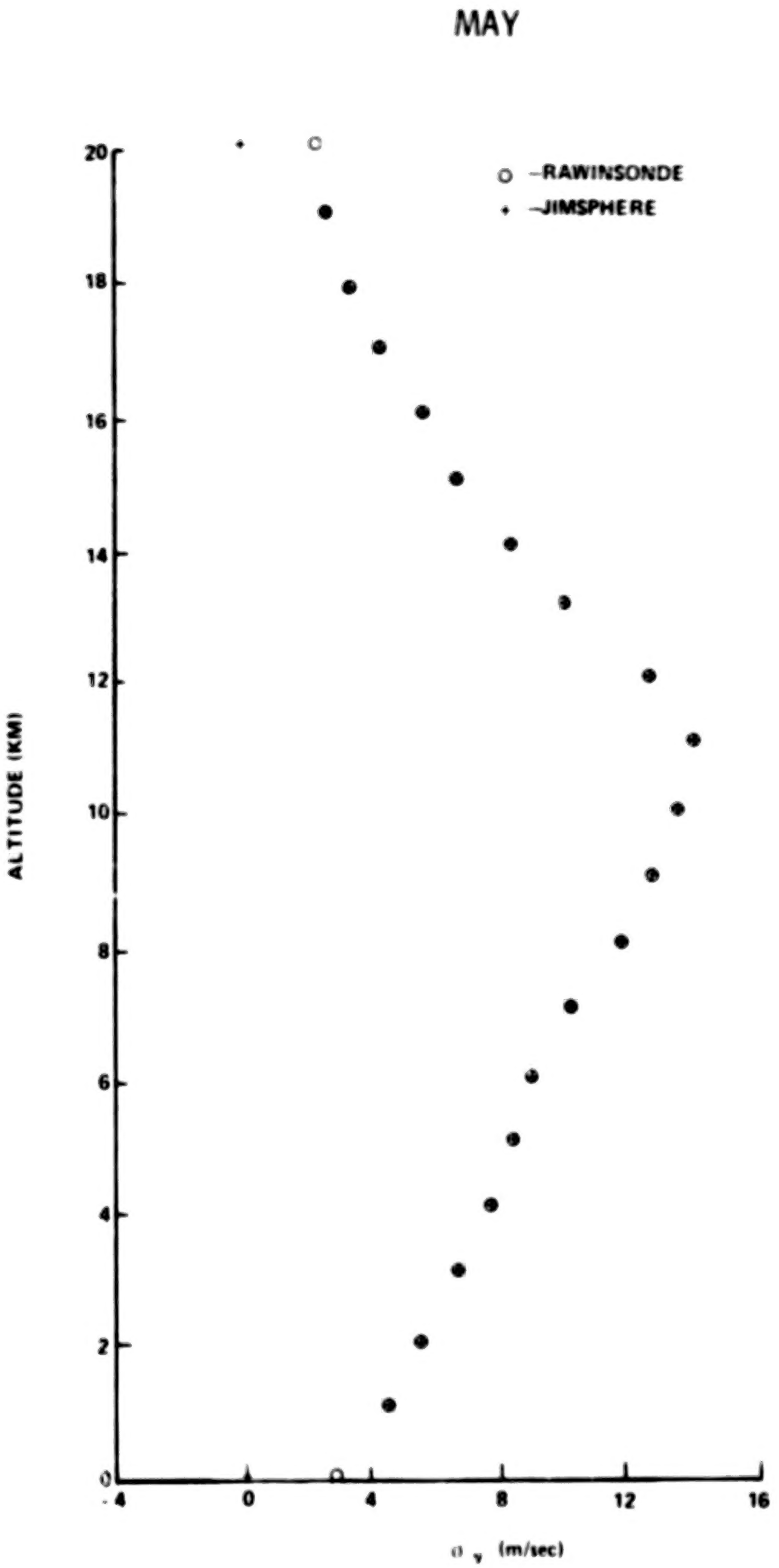

Figure 42. Comparison of the standard deviation for the May meridional wind component profiles for the simulated Jimsphere and rawinsonde data.

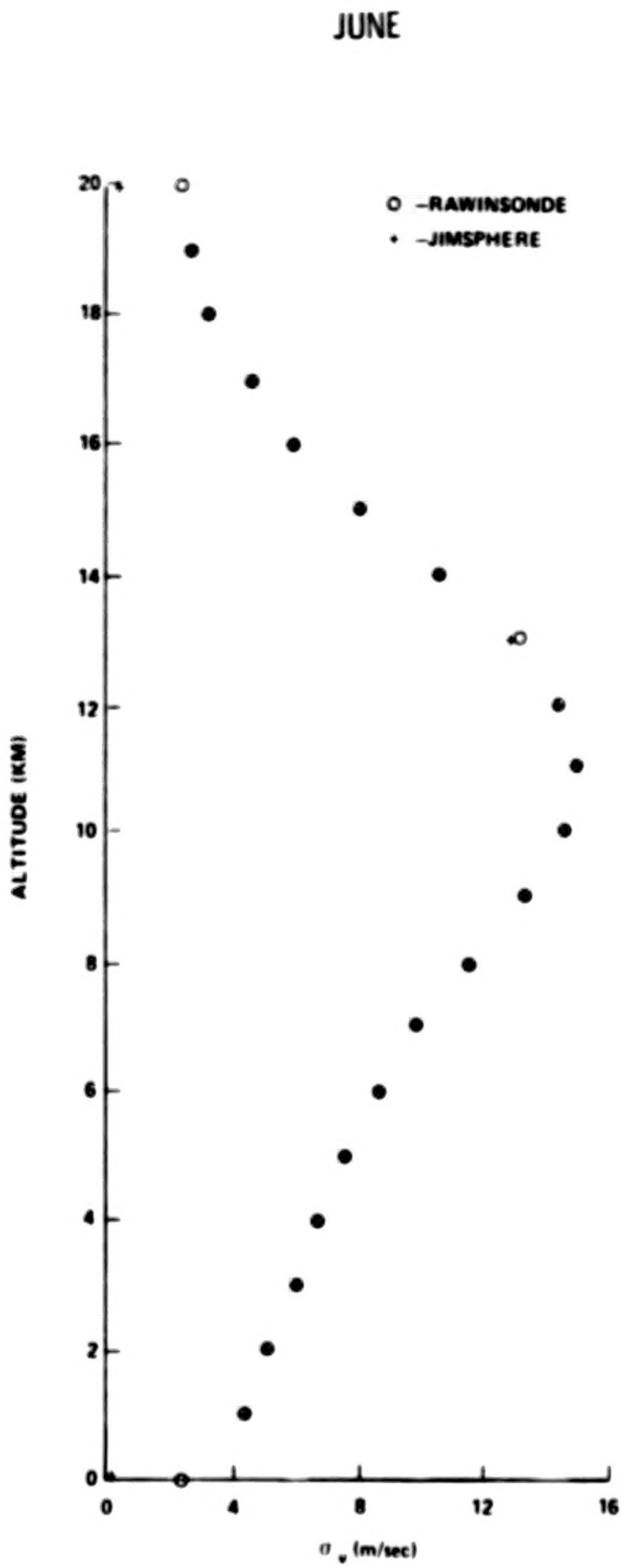

Figure 43. Comparison of the standard deviation for the June meridional wind component profiles for the simulated Jimsphere and rawinsonde data.

JULY

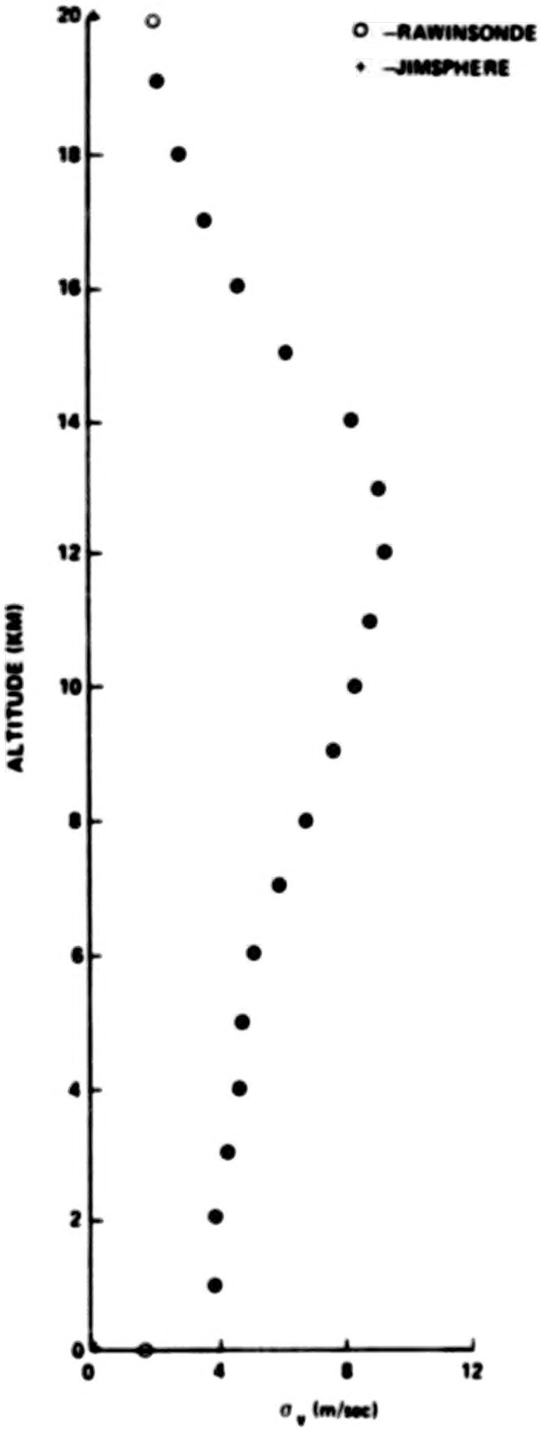

Figure 44. Comparison of the standard deviation for the July meridional wind component profiles for the simulated Jimsphere and rawinsonde data.

AUGUST

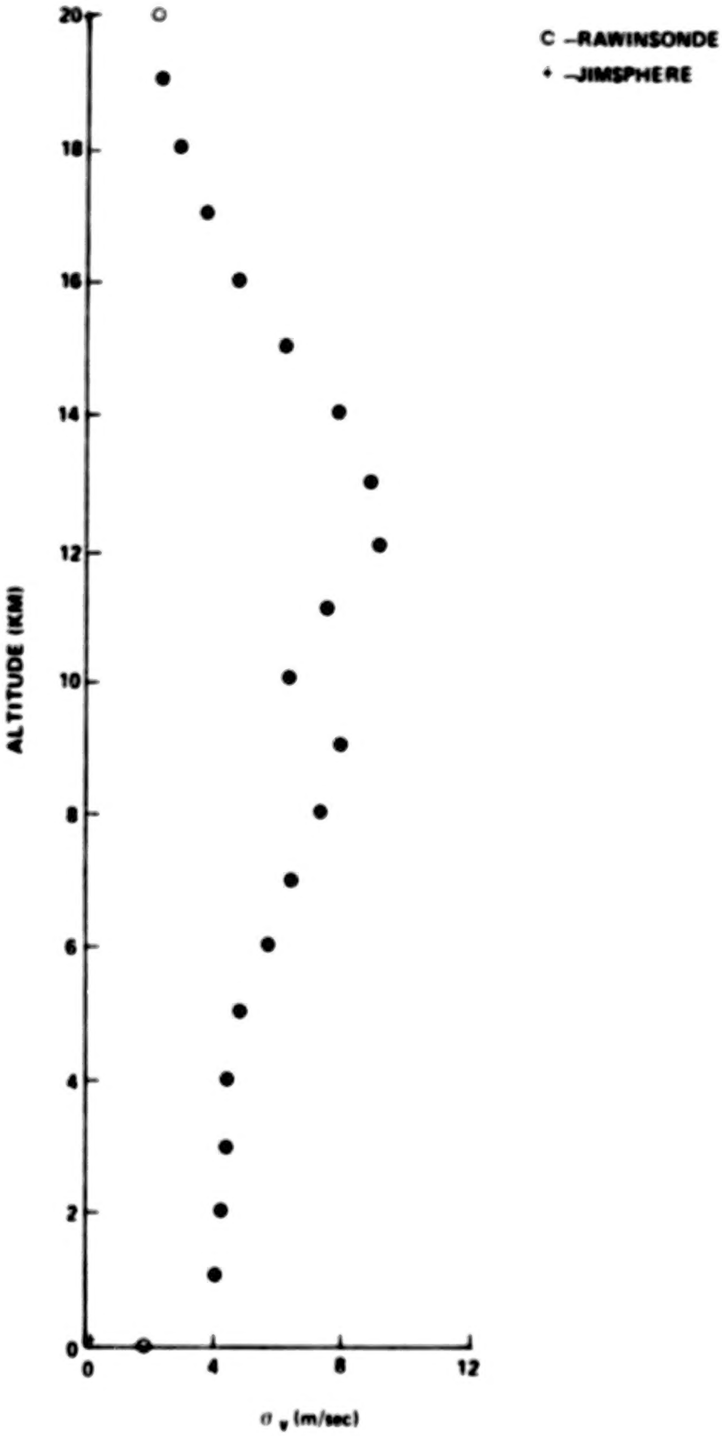

Figure 45. Comparison of the standard deviation for the August meridional wind component profiles for the simulated Jimsphere and rawinsonde data.

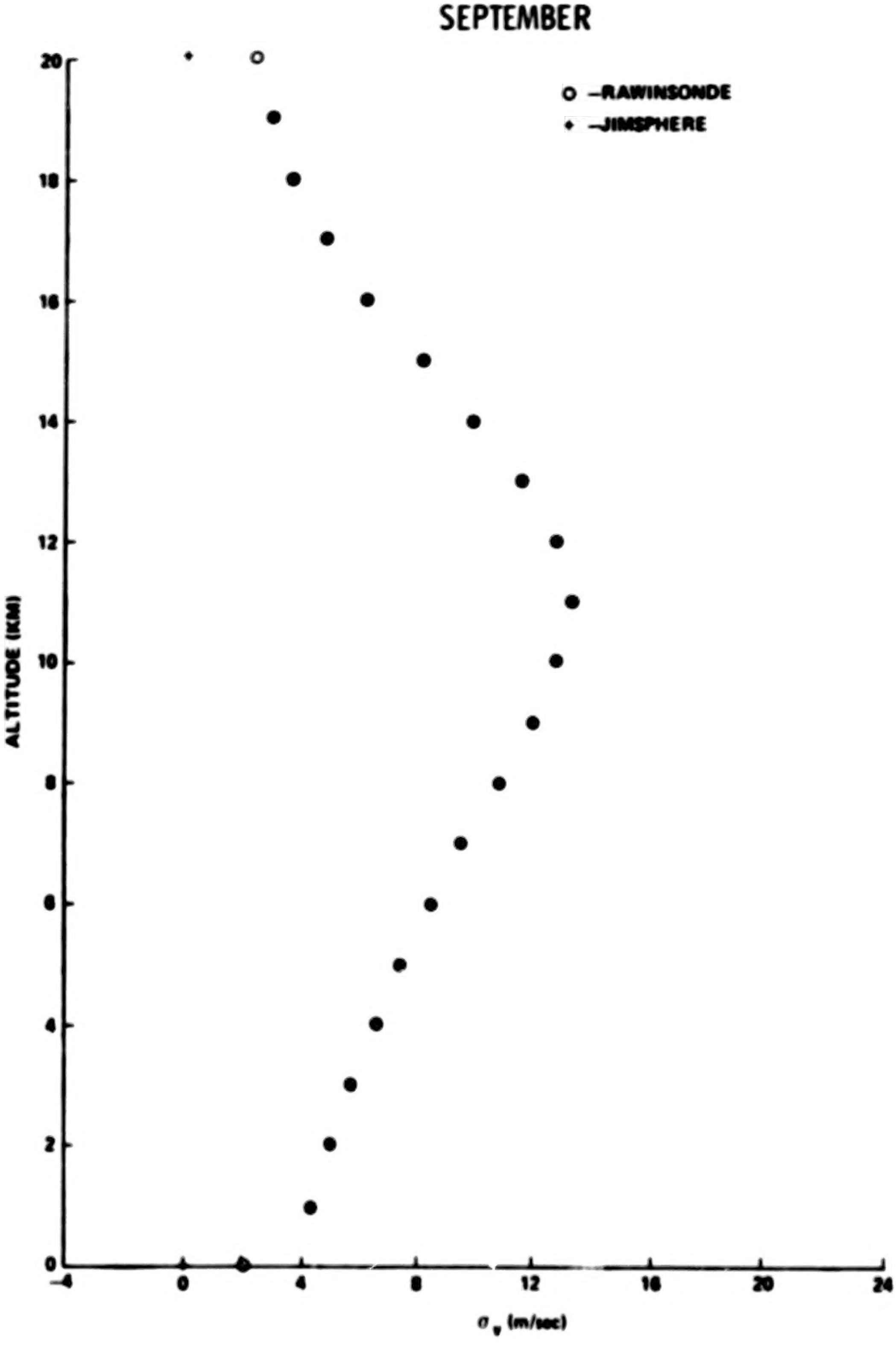

Figure 46. Compa.ison of the standard deviation for the September meridional wind component profiles for the simulated Jimsphere and rawinsonde data.

OCTOBER

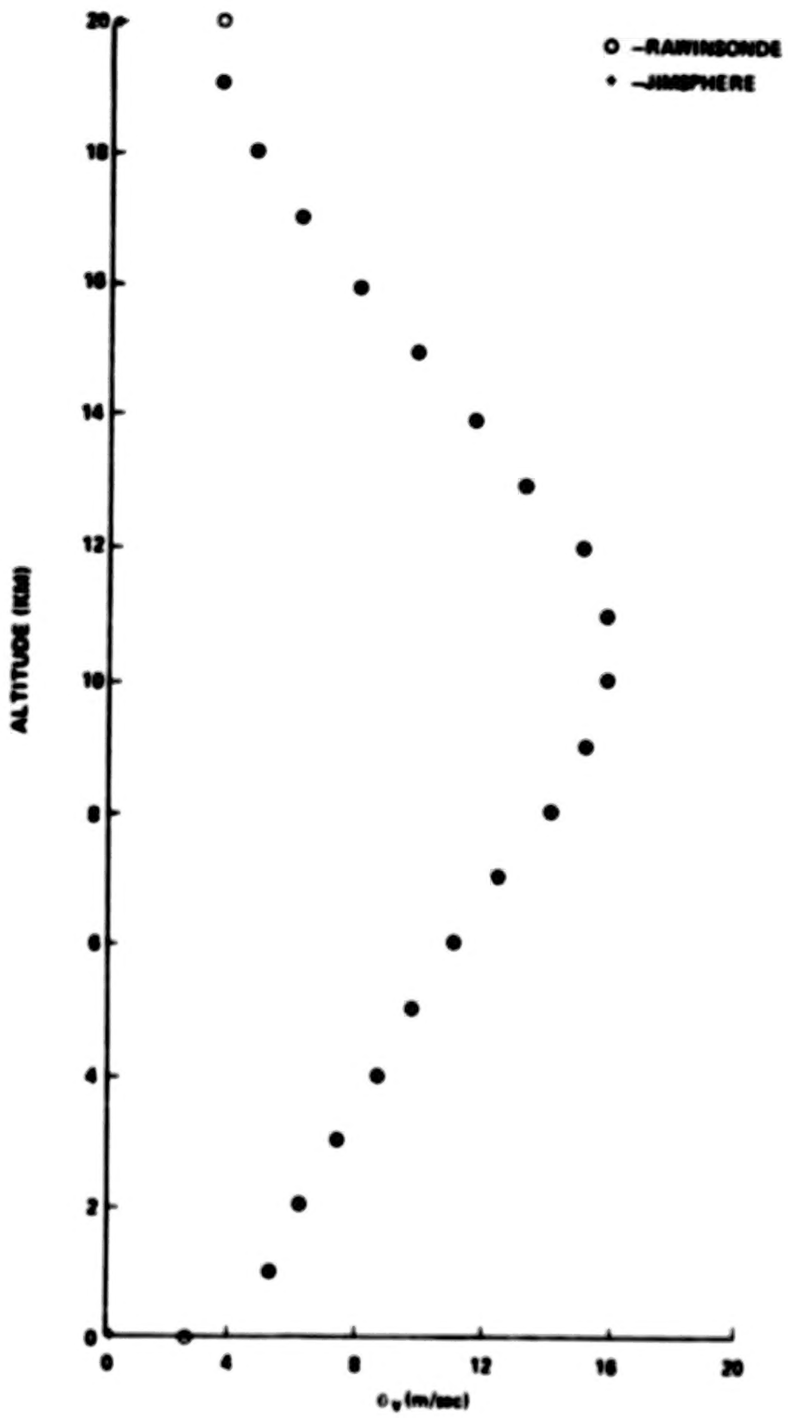

Figure 47. Comparison of the standard deviation for the October meridional wind component profiles for the simulated Jimsphere and rawinsonde data.

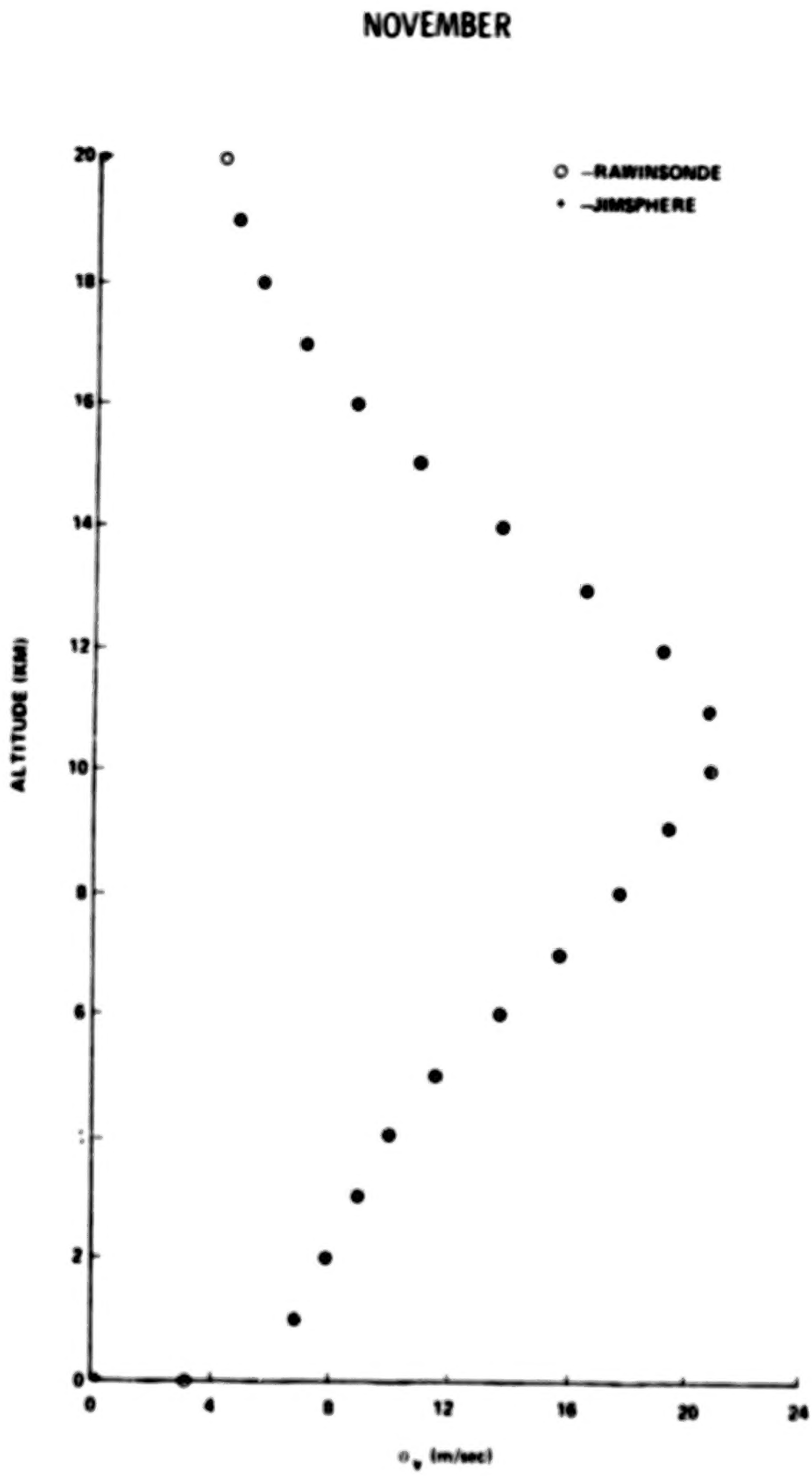

Figure 48. Comparison of the standard deviation for the November meridional wind component profiles for the simulated Jimsphere and rawinsonde data.

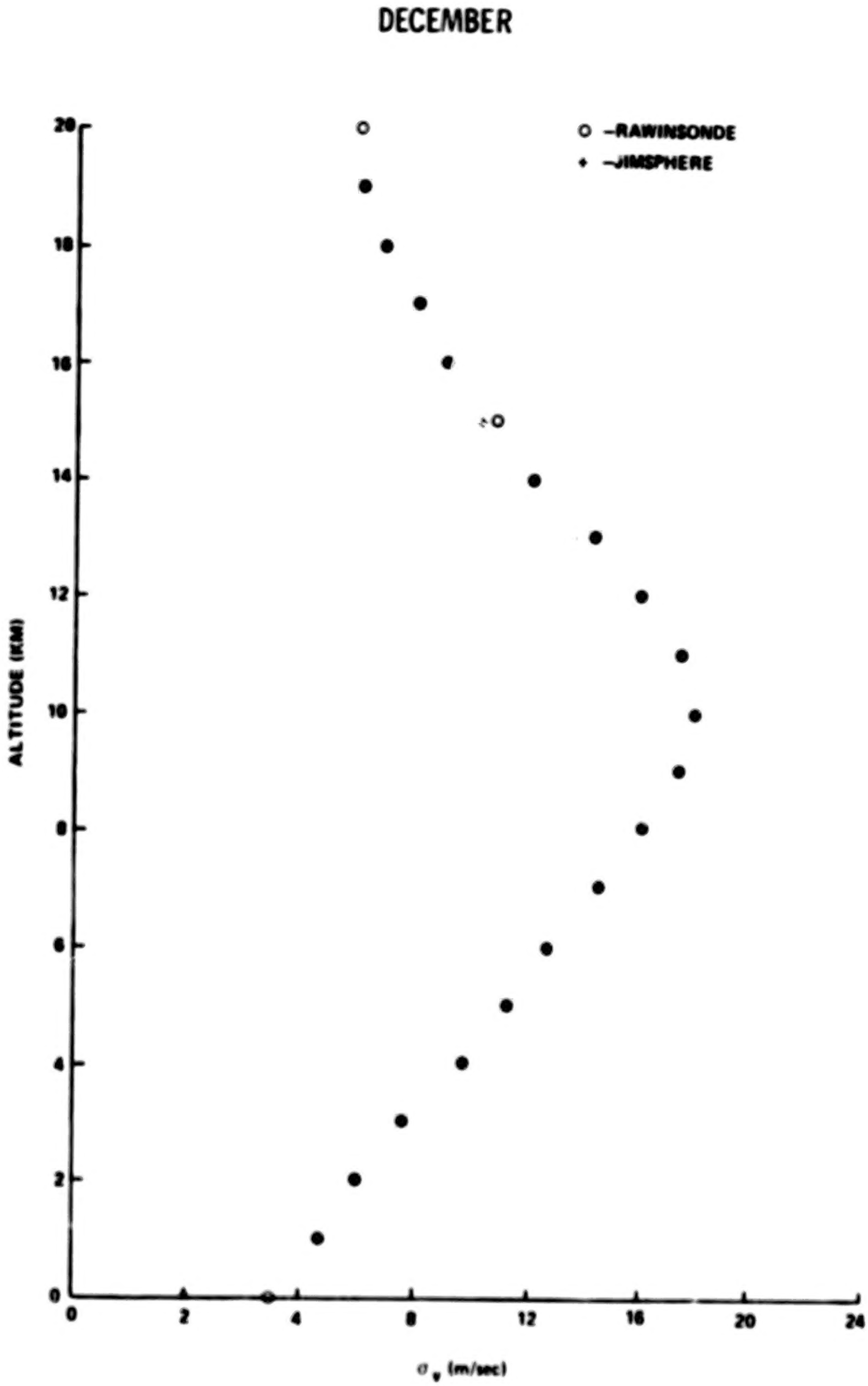

Figure 49. Comparison of the standard deviation for the December meridional wind component profiles for the simulated Jimsphere and rawinsonde data.

$$R(u,v) = \frac{\overline{uv} - \bar{u}\,\bar{v}}{\sigma_u \sigma_v} \tag{3.4}$$

where

$$\overline{uv} = \frac{1}{N} \sum_{k=1}^{N} uv \tag{3.5}$$

and N is as indicated previously. The results are illustrated in Figures 50 through 61. The agreement for the correlation coefficients, like that of the mean wind components and standard deviation, was found to be excellent.

The final check made relative to the quality of the simulated data was that of a comparison between plotted wind speed profiles for the simulated Jimsphere, rawinsonde, and real Jimsphere data. Three wind speed cases were used: a low, medium, and high wind speed profile. These cases are illustrated in Figures 62 through 64. While it is readily seen that there are some differences between the plots, there is excellent agreement from an overall standpoint.

While the discussion of data quality presented in this chapter is not a vigorous mathematical presentation, it nevertheless shows from a qualitative standpoint that the simulated Jimsphere data is indeed a good representation of real Jimsphere data.

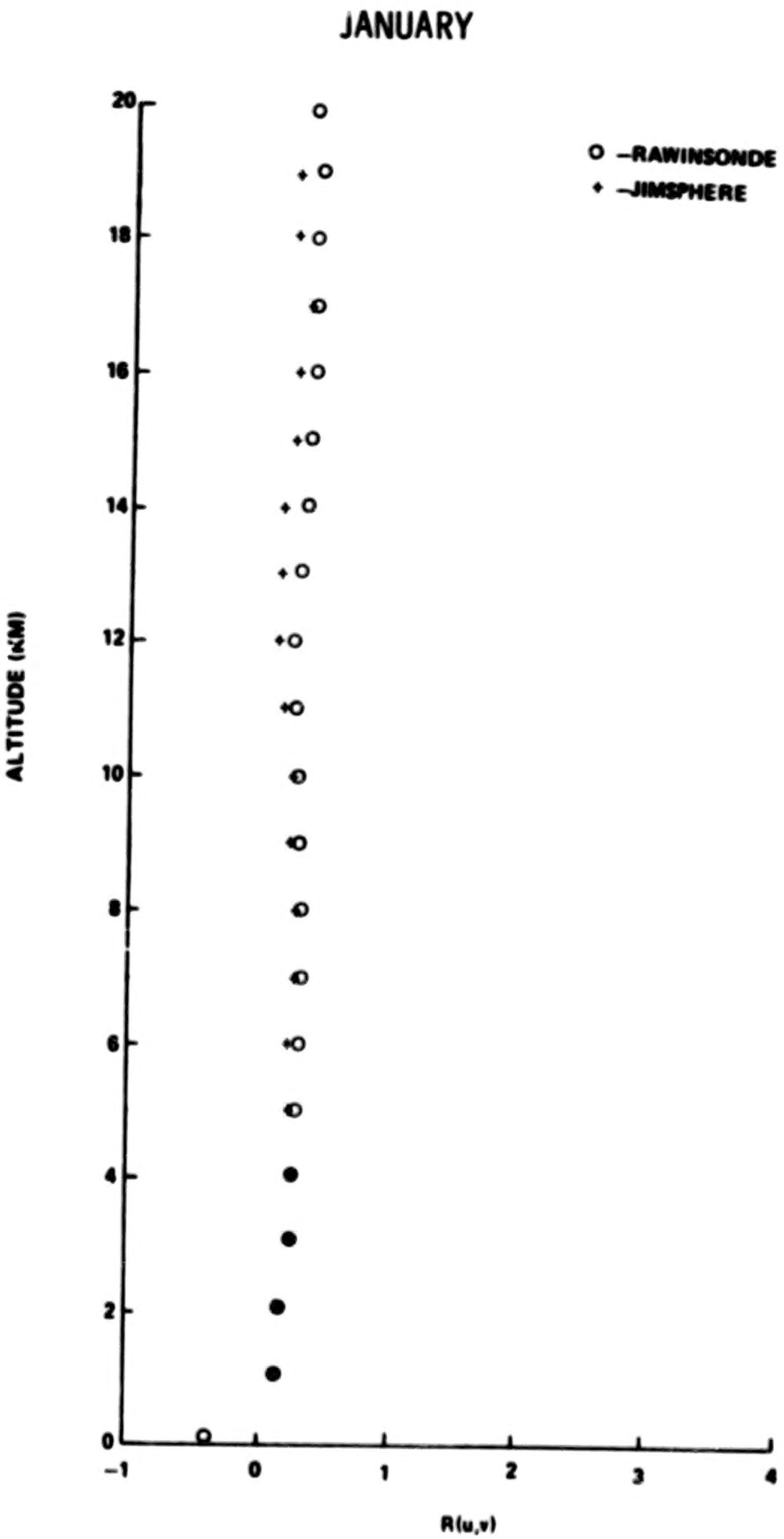

Figure 50. Comparison of the correlation coefficients for the January simulated Jimsphere and rawinsonde data.

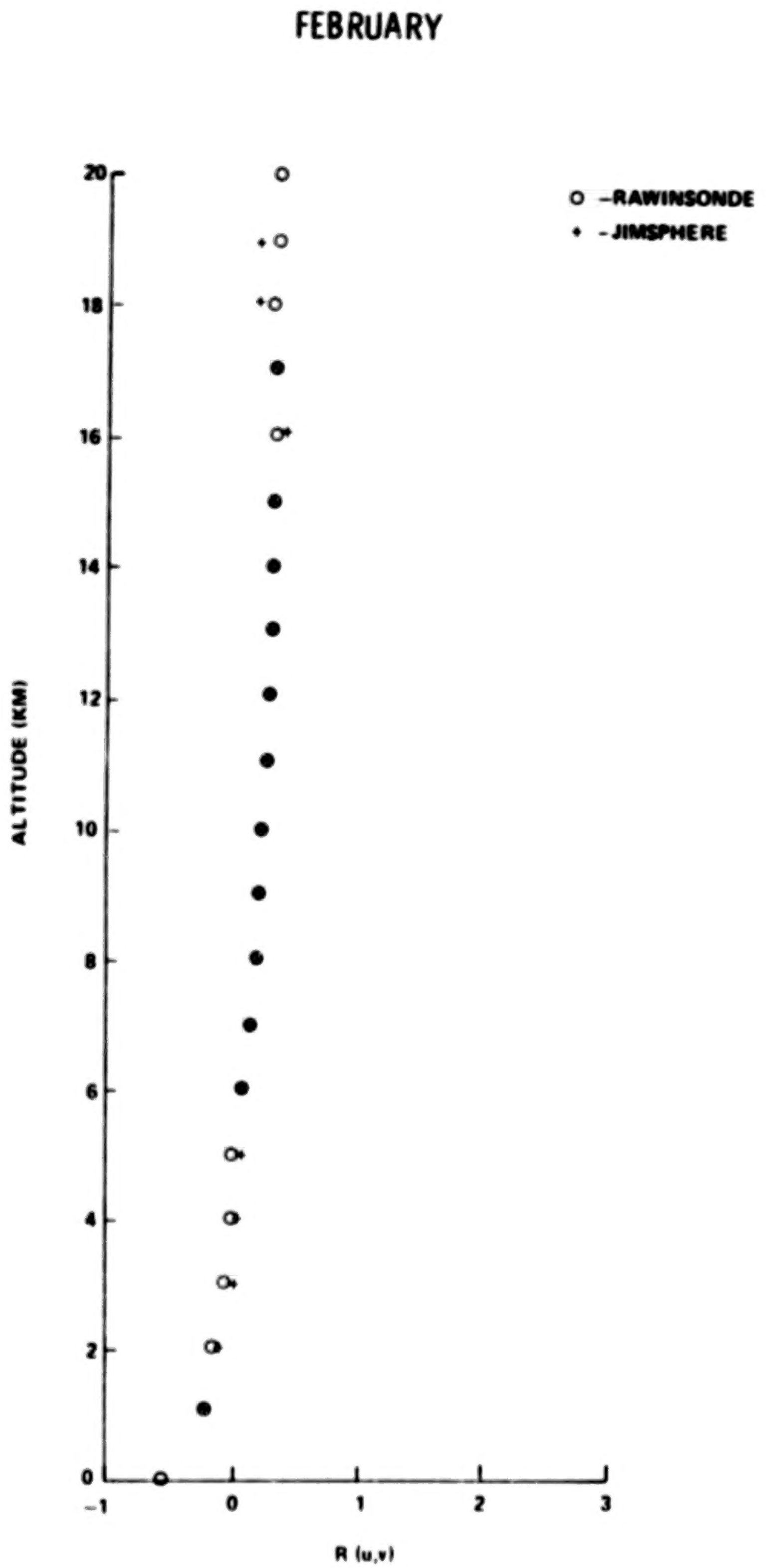

Figure 51. Comparison of the correlation coefficients for the February simulated Jimsphere and rawinsonde data.

MARCH

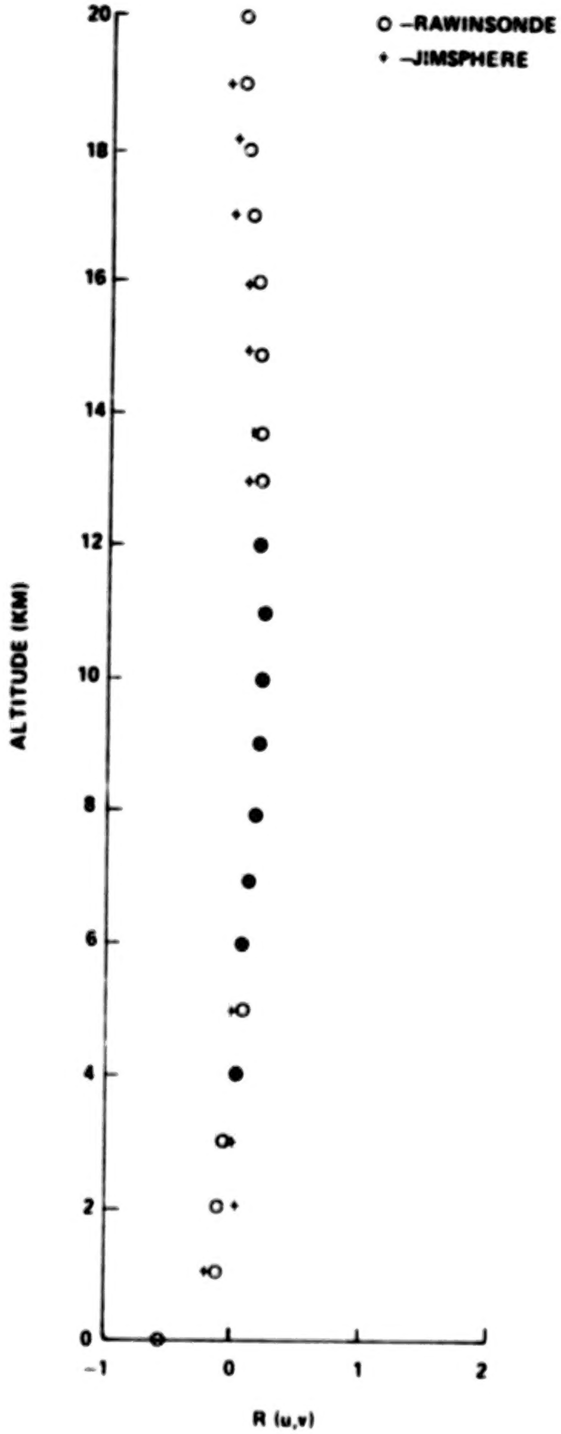

Figure 52. Comparison of the correlation coefficients for the March simulated Jimsphere and rawinsonde data.

APRIL

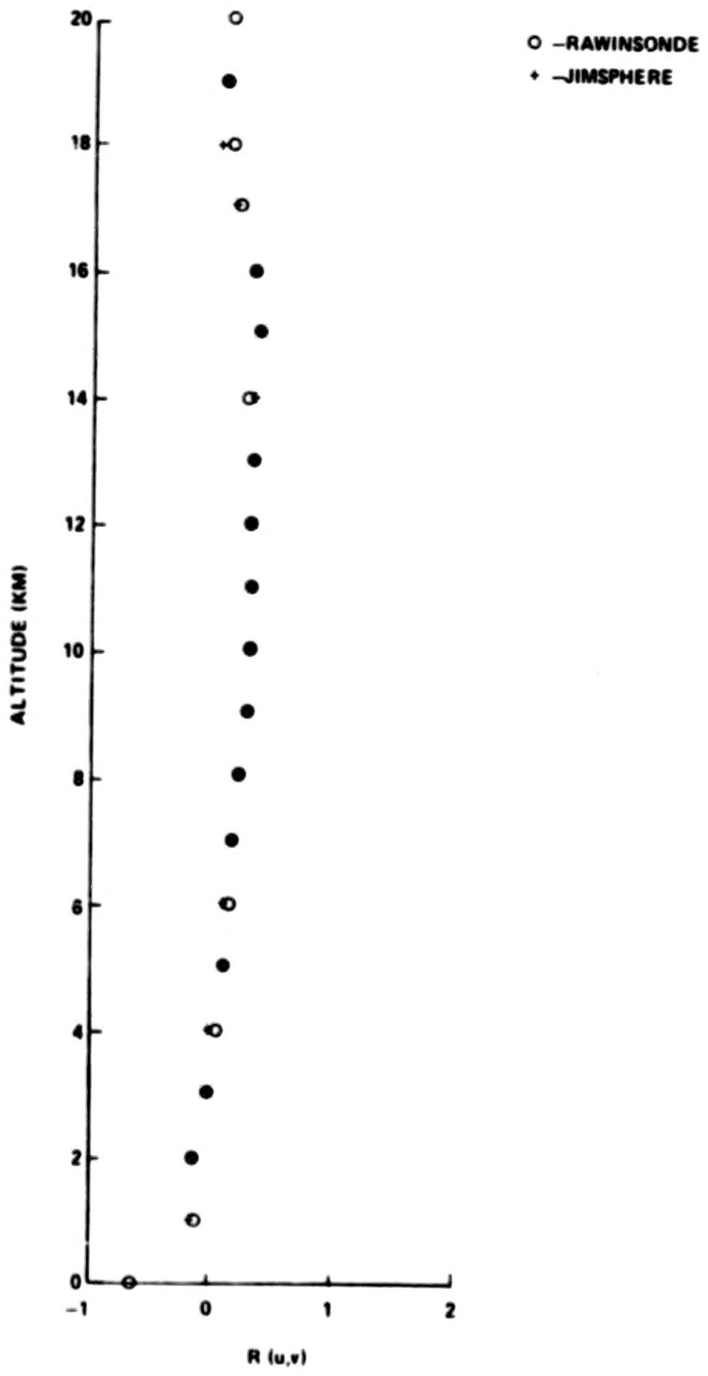

Figure 53. Comparison of the correlation coefficients for the April simulated Jimsphere and rawinsonde data.

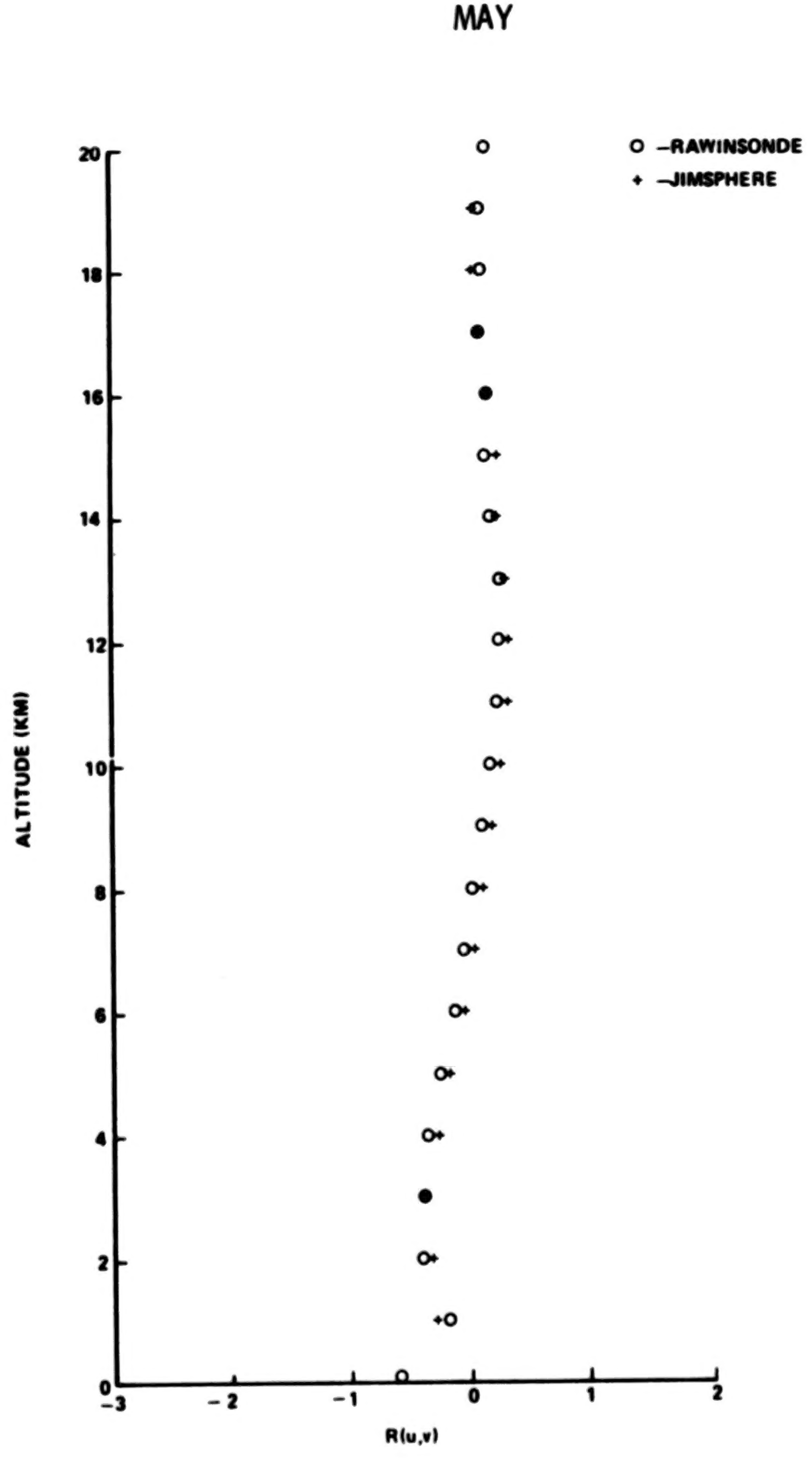

Figure 54. Comparison of the correlation coefficients for the May simulated Jimsphere and rawinsonde data.

JUNE

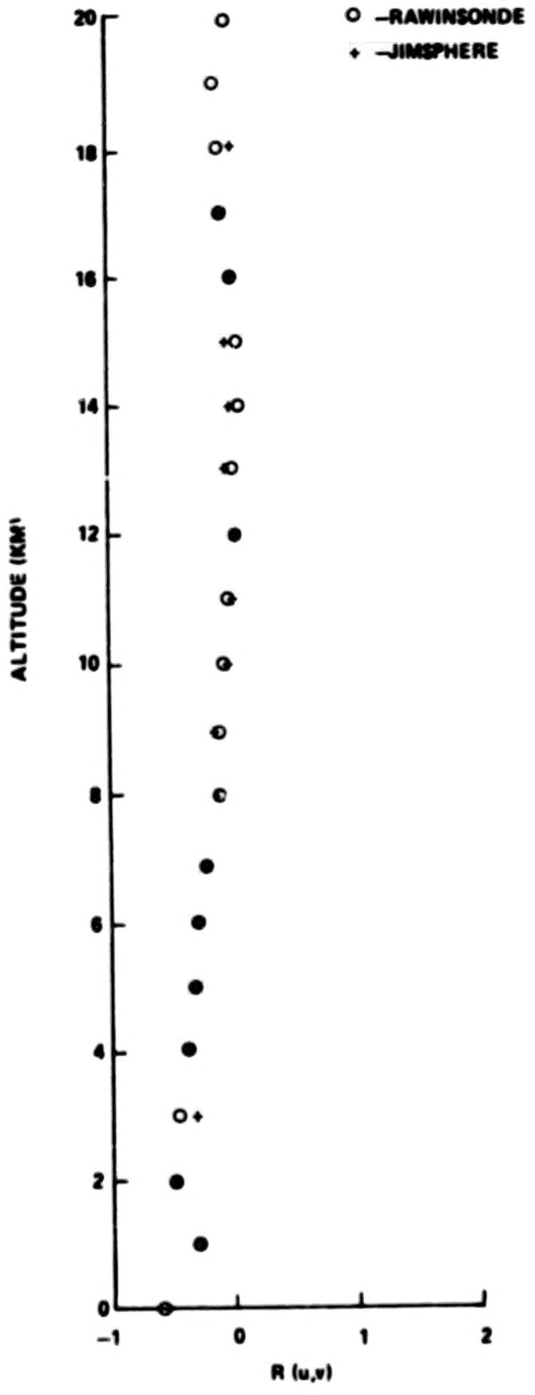

Figure 55. Comparison of the correlation coefficients for the June simulated Jimsphere and rawinsonde data.

JULY

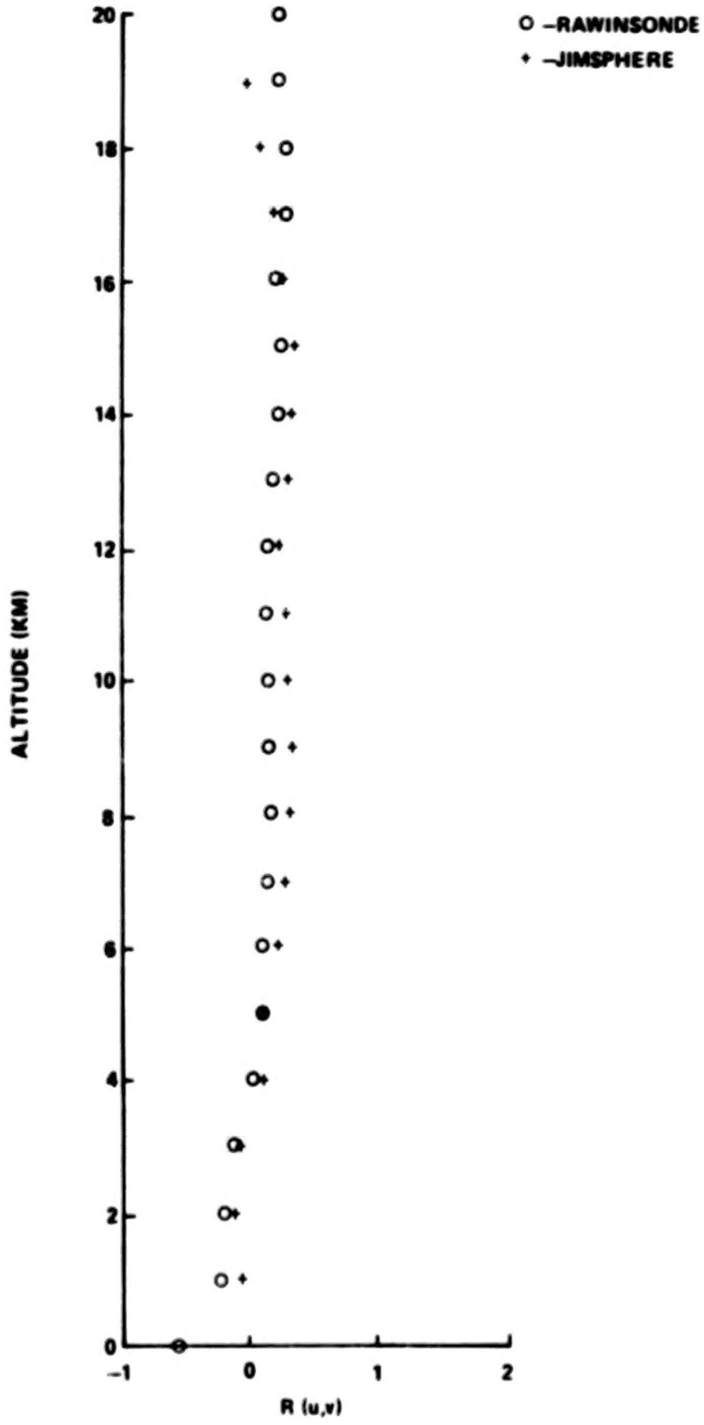

Figure 56. Comparison of the correlation coefficients for the July simulated Jimsphere and rawinsonde data.

AUGUST

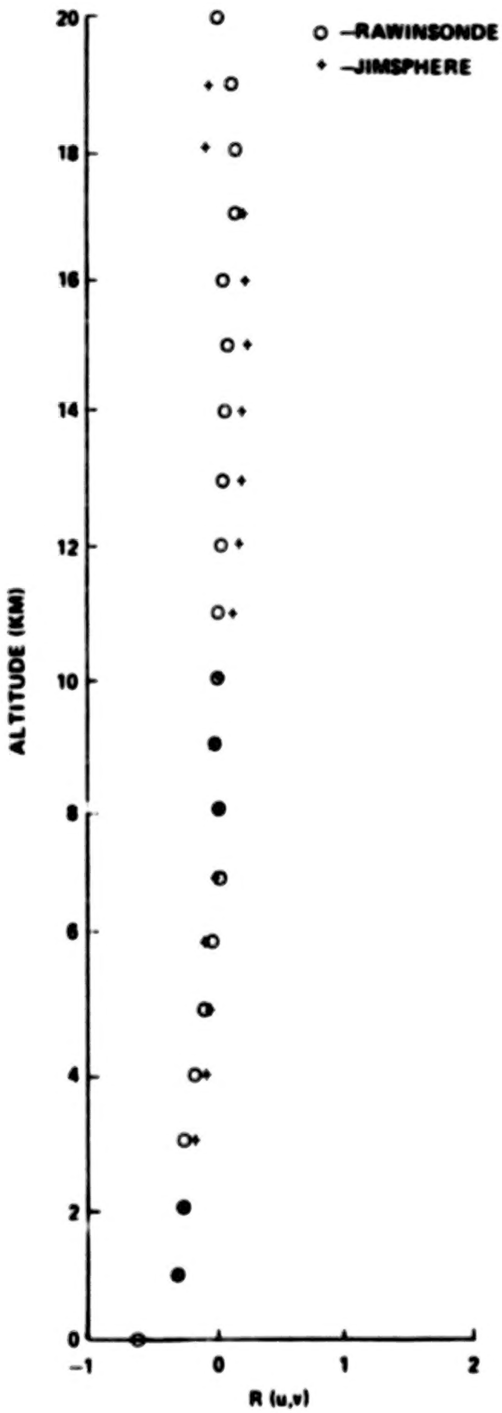

Figure 57. Comparison of the correlation coefficients for the August simulated Jimsphere and rawinsonde data.

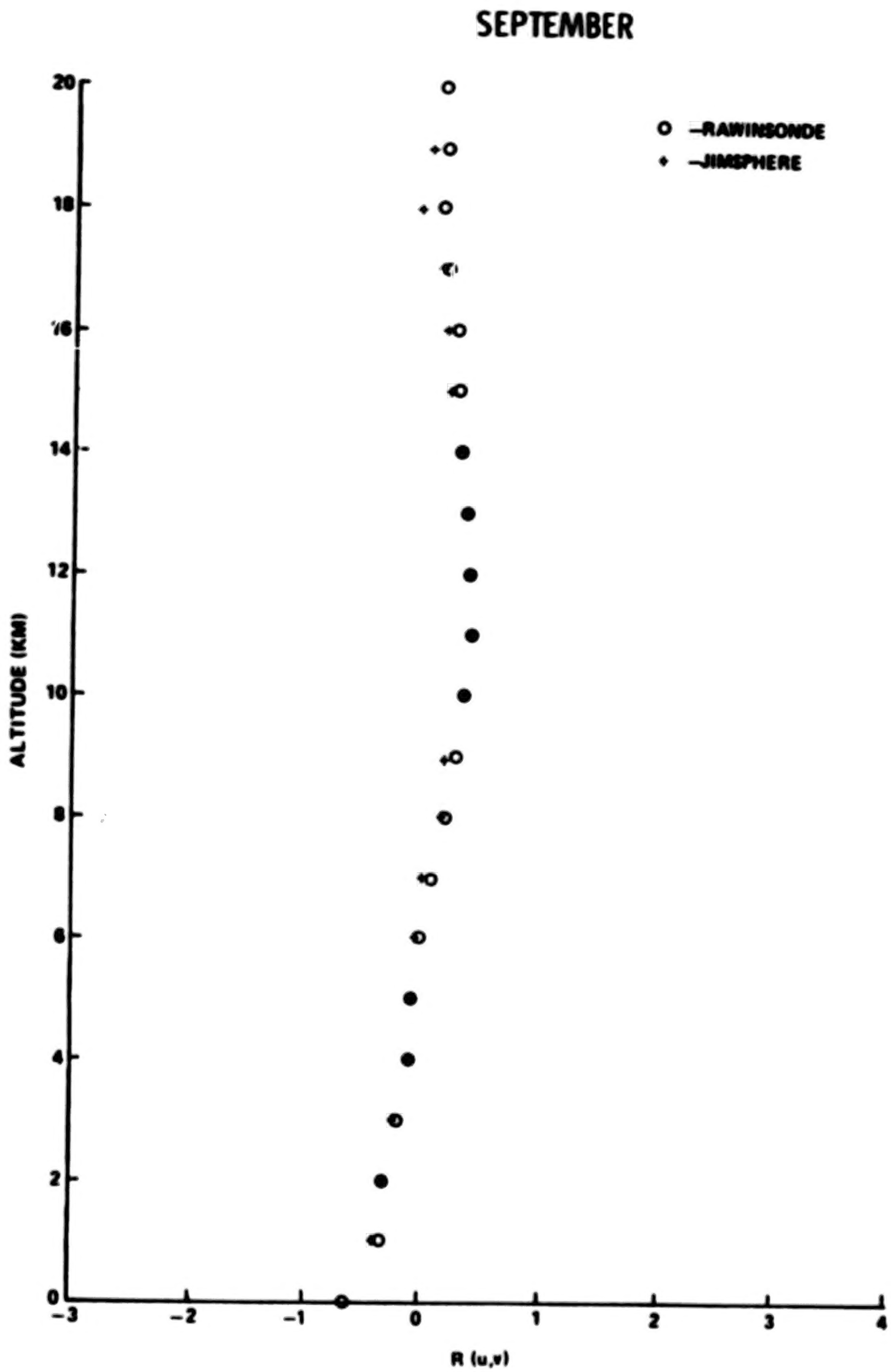

Figure 58. Comparison of the correlation coefficients for the September simulated Jimsphere and rawinsonde data.

OCTOBER

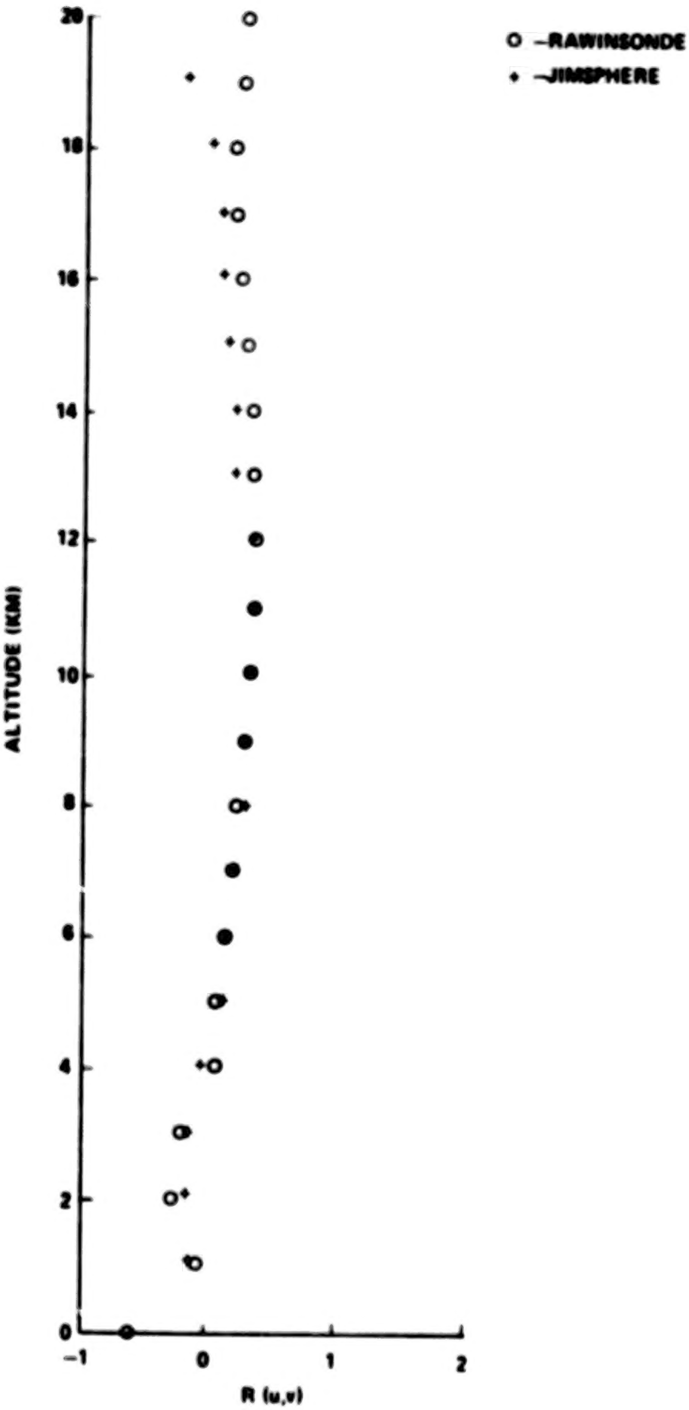

Figure 59. Comparison of the correlation coefficients for the October simulated Jimsphere and rawinsonde data.

NOVEMBER

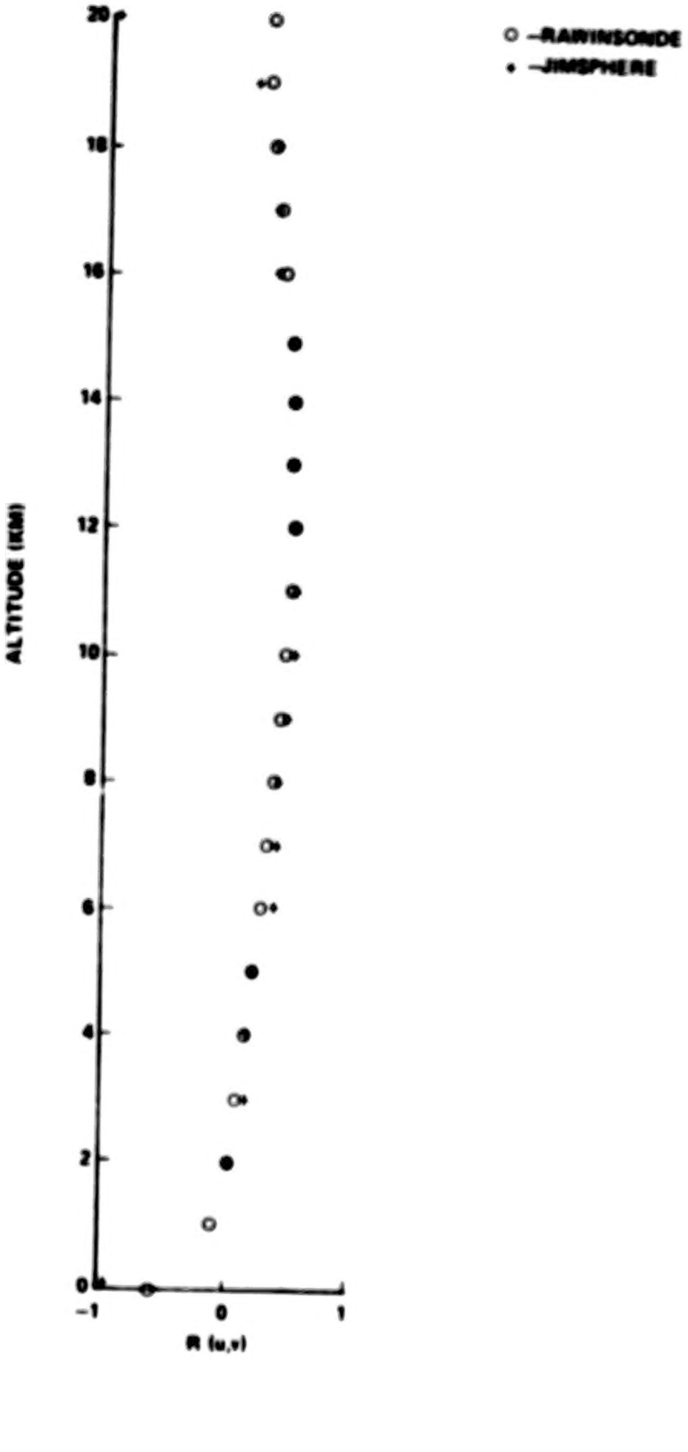

Figure 60. Comparison of the correlation coefficients for the November simulated Jimsphere and rawinsonde data.

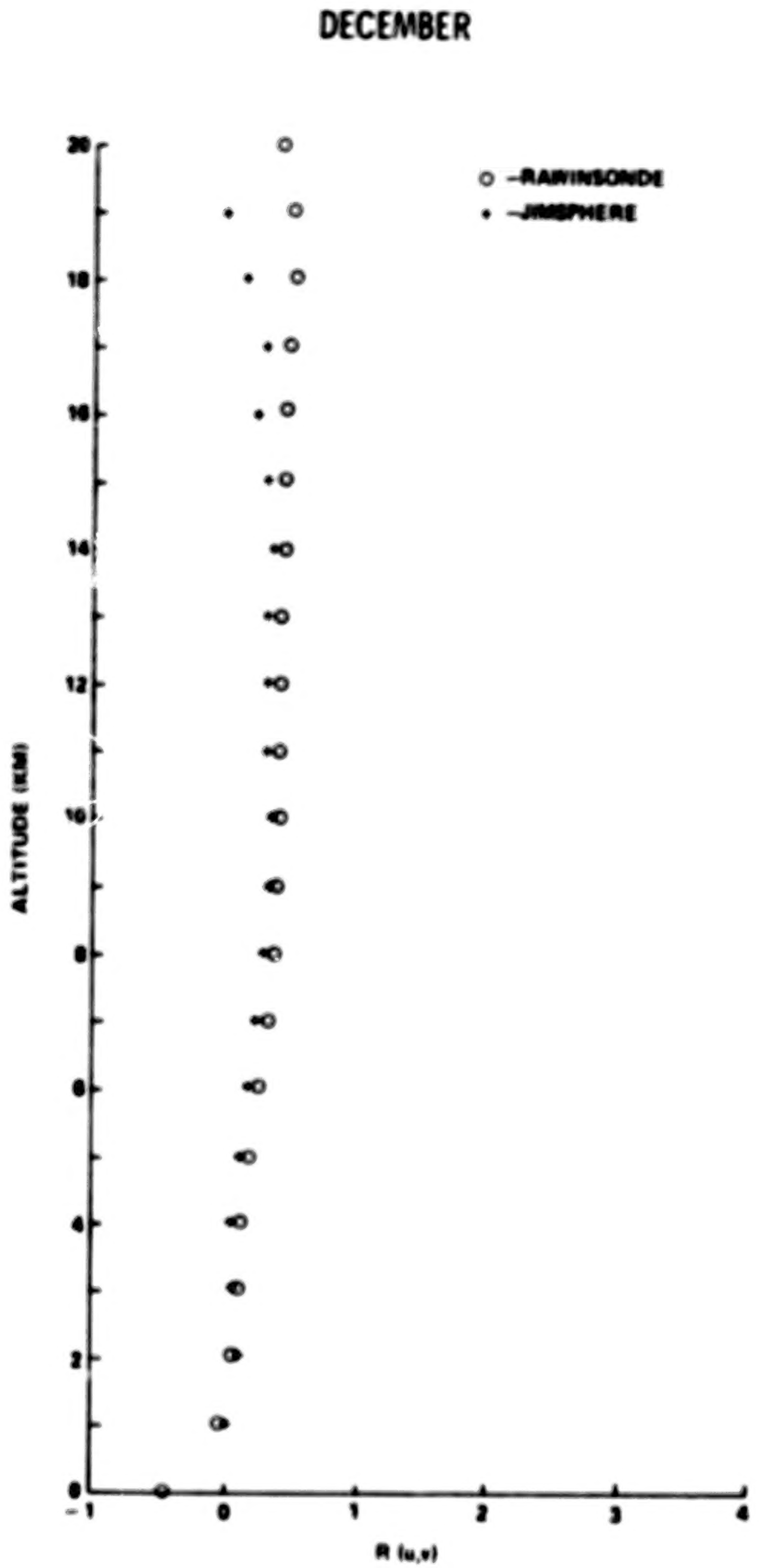

Figure 61. Comparison of the correlation coefficients for the December simulated Jimsphere and rawinsonde data.

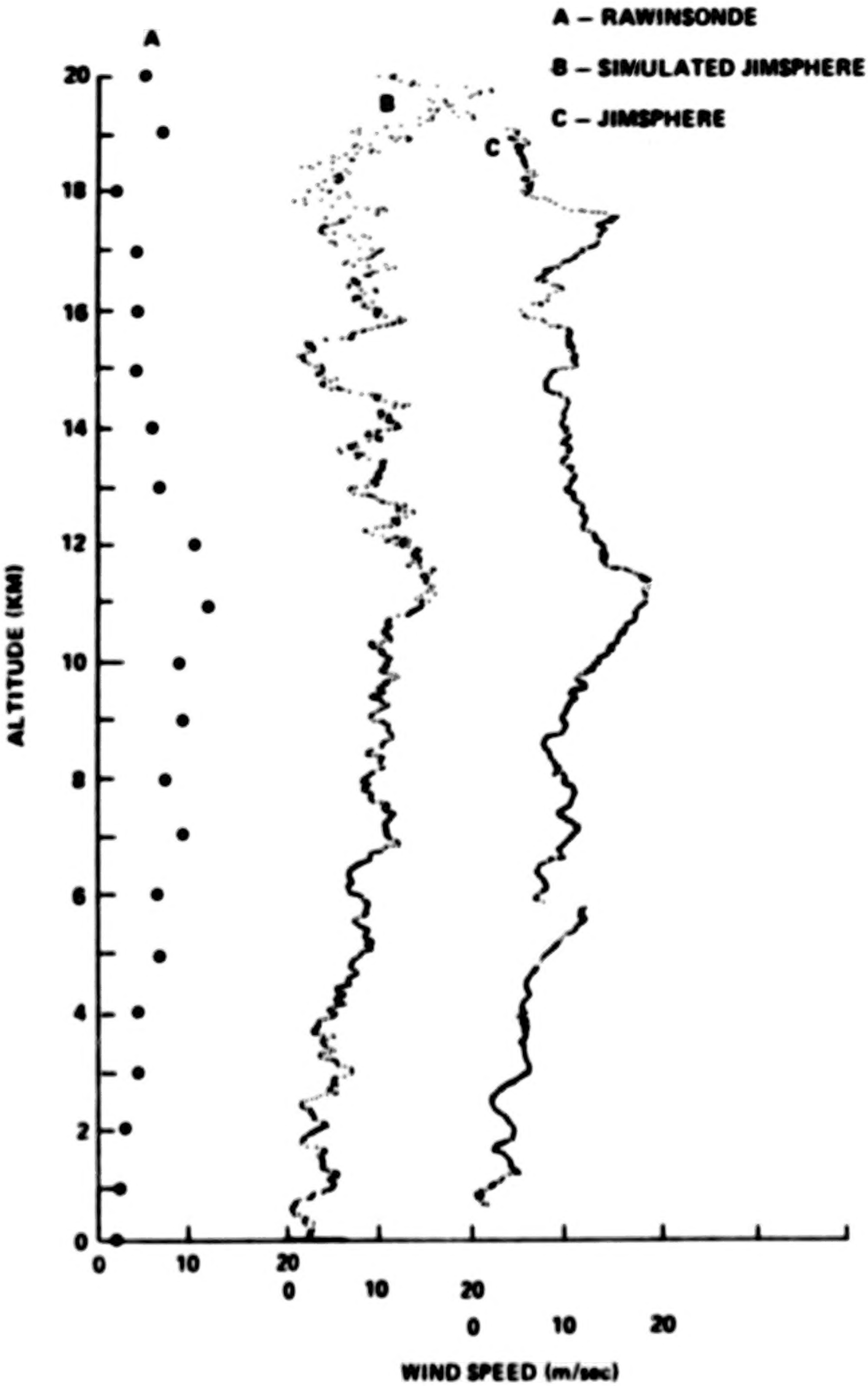

Figure 62. Comparison of scalar wind profile for a low wind speed case for rawinsonde, simulated Jimsphere and Jimsphere data.

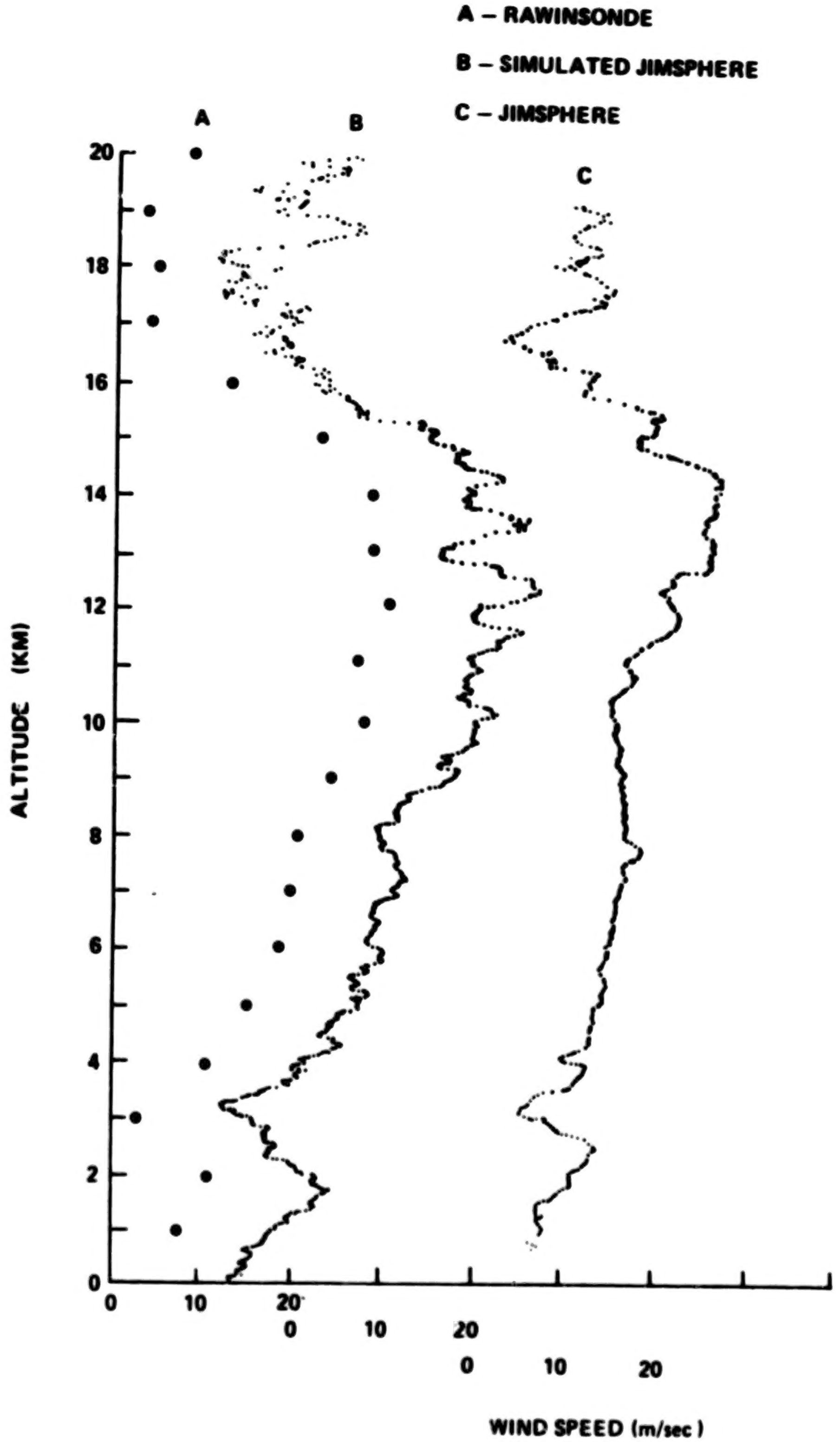

Figure 63. Comparison of scalar wind profile for a medium wind speed case for rawinsonde, simulated Jimsphere and Jimsphere data.

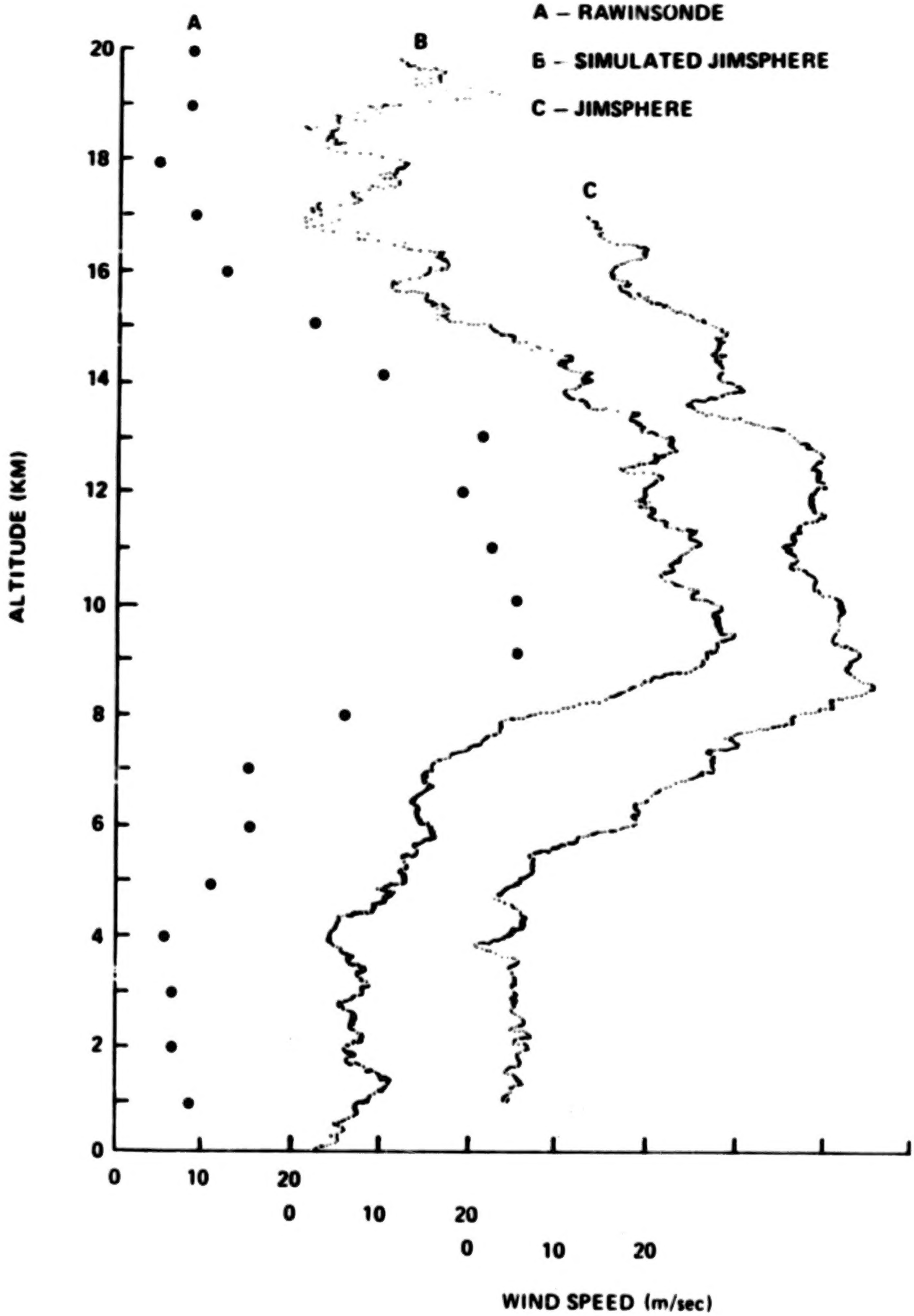

Figure 64. Comparison of scalar wind profile for a high wind speed case for rawinsonde, simulated Jimsphere and Jimsphere data.

CHAPTER IV

DATA TAPE FORMAT USED FOR STORAGE OF SIMULATED JIMSPHERE PROFILES

In order that the Marshall Space Flight Center simulated Jimsphere verification data for Vandenberg Air Force Base be readily available to potential users, it is necessary for it to be in a form that may be easily utilized. The technique selected for these data is to store the data on magnetic tape. The following information concerning the format of the data tapes for the simulated Jimsphere verification wind profile data for Vandenberg Air Force Base, California, is given to permit this utilization to be achieved:

a. The data are chronologically sorted by month; i.e., there are 12 tapes, one for each month. Each tape contains 150 wind profiles. Tape 1 contains data in chronological order for the month of January for the years of 1965 through 1972; tape 2 is for February for the years of 1965 through 1972; ... ; tape 12 is for December for the years of 1965 through 1972.

b. The data on the tapes were compiled on the DDP-224 computer using assembly language.

c. Each record contains one profile (3208 words); each file contains one month of data (150 profiles);

each word has 24 bits; and each tape has one file.

Words 1 through 4 of each record are identification written in fixed point binary where

Word

1 = Dummy test number

2 = Dummy number and year (last two digits of the year, i.e., 1970 = 70)

3 = Month and day (Jan. = 01, Feb. = 02, ..., Dec. = 12; days are 01, first day, 02, second day, ...)

4 = Hour of release (Greenwich time to nearest minute)

Words 5 through 3208 of each record are floating point binary consisting of wind speed and wind direction.

Words		
5 & 6	Wind speed (m/sec)	for zero meters (sfc)
7 & 8	Wind direction (deg)	for zero meters (sfc)
9 & 10	Wind speed (m/sec)	for 25 m altitude
11 & 12	Wind direction (deg)	for 25 m altitude
	...	...
	...	...
3205 & 3206	Wind speed (m/sec)	for 20,000 m altitude
3207 & 3208	Wind direction (deg)	for 20,000 m altitude

The format presented here is the same as that used for the Jimsphere verification data for the Cape Kennedy, Florida, area. Thus, there is a continuity between the two sets of verification data.

CHAPTER V

SUMMARY AND RESULT

With the advent of the Space Shuttle vehicle and the requirement that it be capable of launch from both the Kennedy Space Center and Vandenberg Air Force Base, it was necessary that wind verification data be available from both sites. The necessary data for the eastern launch site, Kennedy Space Center, Florida, has been available for several years, namely, the Jimsphere wind data for design verification. However, there were no similar data for the western launch site, Vandenberg Air Force Base, California.

To meet the requirement for verification data for Vandenberg Air Force Base, a procedure was developed using wind gust data from the Kennedy Space Center and rawinsonde data from Vandenberg Air Force Base to construct simulated Jimsphere wind profile data. The utilization of this procedure has been presented and the quality of the data obtained by the procedure has been discussed from a qualitative pseudo-quantitative standpoint. The quality of the data has been shown to be in good agreement, from a comparative standpoint, with real Jimsphere data.

The data resulting from the procedure presented are presently being used in the Space Shuttle Program. The data is currently being used in verifying some of the design aspects of the vehicle but will be more widely used in prelaunch studies relative to the Space Shuttle.

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BIBLIOGRAPHY

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16. ABSTRACT

The FPS-16 radar/Jimsphere system used to obtain wind profile data for the altitude layer between the surface and approximately 18 km provides the most accurate and detailed wind measurements currently available. Therefore, this type of data has proven to be of exceptional value for use in aerospace research and development programs. With the advent of the Space Shuttle program, the importance of this type of data was again noted. However, the quantity of data necessary to provide the reliable high-resolution wind profiles for one of the possible launch sites, Vandenberg Air Force Base, California, was not available. The fact that sufficient time to obtain the data did not exist posed the problem of how the high-resolution wind profiles needed for the Space Shuttle program were to be developed. The method used to resolve this problem is the subject of this report; that is, the derivation of simulated Jimsphere wind profiles from low-frequency rawinsonde data and a generated set of white noise data. A computer program is developed to model high-resolution wind profiles based on the statistical properties of data from the Kennedy Space Center, Florida. Comparison of the measured Jimsphere data, rawinsonde data, and the simulated profiles shows excellent agreement. These simulated Jimsphere wind profiles will be used in design verification studies of the Space Shuttle operation for Vandenberg Air Force Base, California.

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